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ORAL SURGERY
ORAL MEDICINE
and ORAL PATHOLOGY

## EDITORIAL

### DENTAL RADIOLOGY—SPECIALTY STATUS

At the present time certain specialty groups have been recognized by the American Dental Association; others are endeavoring to obtain recognition. In order to avoid undue compartmentalization, consideration is being given to the grouping of certain reasonably compatible activities. Where does dental radiology fit into the composite situation?

In order to develop and teach the science of radiology most effectively, one should have a suitable background in oral pathology, oral diagnosis, and oral medicine. In addition, because of the physical aspects of the science, a knowledge of basic and radiation physics as well as of biology and genetics is important. If a grouping were to be developed, perhaps the most suitable combination for the dental radiologist would be with the oral pathology and/or the oral medicine groups. It is entirely possible, and quite understandable, that a reciprocal sentiment may not exist.

Perhaps this is not a proper time to "pressure" for specialty status. There is serious question whether the body of knowledge called "dental radiology" is sufficiently large to justify the claim for specialization. Furthermore, the number of persons who could be classified as bona fide specialists is small. Research activities dedicated to the development of new knowledge are limited.

This is not to suggest that a specialty of dental radiology could not or should not be developed. Actually, the *potential* scope of the science is sufficiently broad to warrant a specialty classification per se. The number of persons becoming active in the field is increasing slowly, and the quality of the work shows substantial progress. Dental school administrations have traditionally considered their x-ray departments to have a service function and have restricted development through excessive demands which could have been filled by technical personnel. To some extent, this attitude is changing. Teachers of the subject are recognizing the need for a basic understanding of the physical and biologic sciences and are preparing objectively for their teaching. Graduate education opportunities have become available. Only recently a noncommercially supported literary outlet has been developed specifically for the publication of material on dental radiology. The science of dental radiology is growing!

It might be entirely advisable for those interested in dental radiology to bide their time, develop their science, and make their demands at a later date. There is no deadline; specialty status comes to him who waits—and works!

*Arthur H. Wuehrmann*

## OPERATIVE ORAL SURGERY

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# SUBPERIOSTEAL VITALLIUM IMPLANTS IN DOGS

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THIS research was not aimed at demonstrating the effectiveness of oral implants, for that already has been widely accepted. Rather, the purpose of the present study was to investigate further two factors which seem to be causing a large portion of the implant failures: (1) the effects of pressure from the implant upon bone and (2) tissue reactions adjacent to the implant posts. Concurrently, an attempt was made to formulate a standard technique of implant insertion.

Since most of the pioneering in this field was completed some time ago, I shall emphasize that no credit should be detracted from the findings of previous investigators.[1-4] However, a careful survey of the literature led to the combining of the most successful elements of the various methods into one method which would give practical and desirable results.

### RESEARCH PROCEDURE

Anesthesia was induced with an intravenous injection of pentobarbital sodium, 30 mg. per kilogram of body weight, and the maxillary alveolar processes of a 26 pound female dog were prepared for an implant by extraction of the premolars and performing the necessary alveoloplasty. The uneven margins of the wound were excised, allowing close approximation, and the gingivae were sutured with interrupted 0000 silk. A similar procedure was carried out on a 51 pound male dog in which the mandibular premolars were extracted. The postextraction courses of both animals were uneventful. Haling occurred, and after twenty-nine days in the case of the female dog and thirty-two days in that of the male there was sufficient resorption of the alveolar processes for a direct bone impression.

### SURGICAL IMPRESSION

Linear incisions were made along the old scars; these were joined, and flaps were developed to expose bone beyond the base of the alveolar processes.

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Good peripheral boundaries were established by exposing bone to the oblique and mylohyoid ridges, high on the maxillae, and on the palate between the edentulous processes in the respective dogs. The tissues were elevated in a single mucoperiosteal layer and retracted with sutures. A minimum amount of methyl methacrylate autopolymerizing resin was molded to the bony surface to form a thin impression tray. The acrylic was cooled with a continuous stream of physiologic saline solution for about eight minutes during the polymerizing period.[5] The tray was removed, trimmed, and loaded with impression material (zinc oxide paste for one dog and a rubber-base material for the other), after which it was firmly replaced over the exposed bone. The rubber-base material proved more satisfactory, since it did not have the friable property of the paste material. Duplicate impressions were made to preclude possible mishaps.

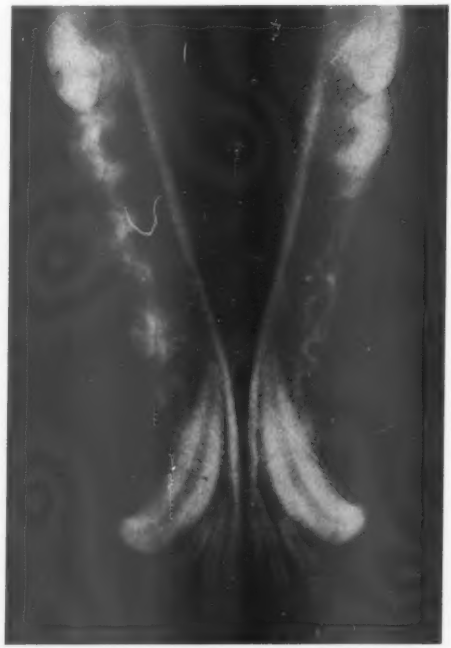

Fig. 1.—Roentgenogram of mandible following extraction of premolars on one side.

The impressions were removed, and the operative site was irrigated with physiologic saline solution. The bone surface was sprinkled with sulfadiazine powder, and the tissues were approximated with interrupted 000 silk sutures. A 2.5 per cent hydrocortisone acetate ointment was applied to the margins of the incisions. The animals were placed on soft diets and high-level doses of

parenteral antibiotics. Regular diets were given after approximately three weeks.[3] The postoperative period was uneventful, and after about three weeks the healing process appeared to be completed. The oral tissues were then ready for insertion of the implants.

### INSERTION OF VITALLIUM IMPLANTS

With the animals under pentobarbital sodium anesthesia, the bone surfaces were exposed by incisions identical to the previous ones and again the flaps were retracted and maintained. The sterile cast-Vitallium implants (which had been rough finished and sandblasted only)[3] were grasped and placed firmly in position. The implants had an excellent adaptation over the contours of the bone. The two implants were secured mechanically with single-strand, 26 gauge stainless steel circumferential wires placed bilaterally in the mandible and two 3/16 inch tantalum screws driven into the palatine and vomer bones, since former unattached implants had become dislodged.

Fig. 2.—Finished Vitallium castings in place on models from surgical impressions.

Again the operative field was irrigated with physiologic saline solution and sprinkled with sulfadiazine powder. The tissues were closely reapproximated and then, with particular care, the gingiva adjacent to the posts was trimmed to provide coaptation and a rolled margin simulating the gingival sulcus. The incisions were closed with interrupted 0000 silk suture material. The animals were given antibiotics and placed on a soft diet, and after approximately three weeks a regular diet was resumed. Healing was uneventful, and the implants remained tightly buried in the tissues for three months. The dogs were then killed, and gross and microscopic studies were made.

GROSS STUDIES AT THREE MONTHS

Clinical examination revealed that the tissues covering the implants were in excellent health. The implants were firmly in place and, even after the screws and wires were removed, great leverage was required to unseat them.

Fig. 3.—Implant in position. Note close adaptation to bony contours of mandible and fixation with circumferential wires.

Fig. 4.—Lateral roentgenogram of maxillary implant.

Periosteum appeared to have grown over the Vitallium framework. Bone beneath the implants was white and compact, and there was no evidence of pathologic change. There were two small areas of exposed Vitallium bilaterally

in the mandibular region. The tissues about these areas appeared healthy, however, so these exposures were assumed to be the result of food abrasion.

MICROSCOPIC STUDIES AT THREE MONTHS*

Sections of soft tissue and bone were made from the specimens. These were fixed in paraffin and stained with acid hematoxylin and aqueous eosin; microscopic examination disclosed a tendency for the squamous epithelium to grow down along the posts, to become thin, and to disappear. A few areas of

Fig. 5.

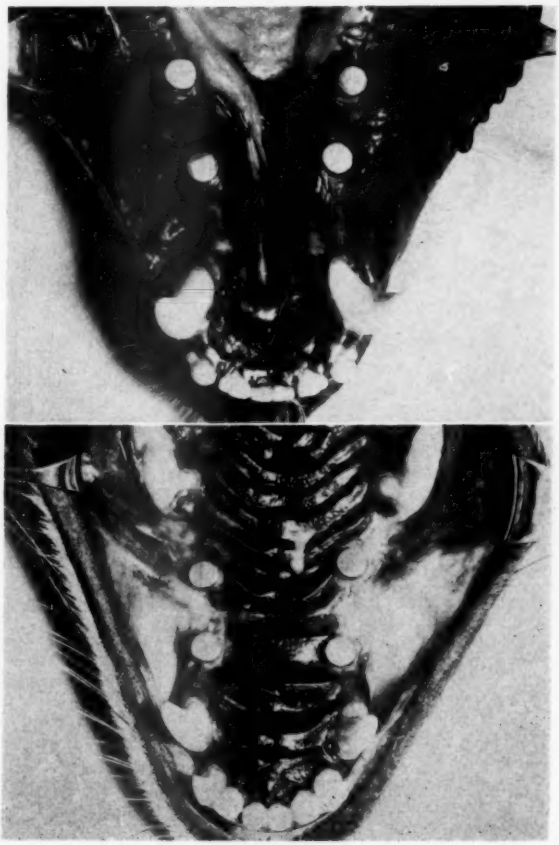

Fig. 6.

Fig. 5.—Mandibular implant after three months. Note the persistence of the minimal sulcus about the posts. There is slight dehiscence of tissue about the Vitallium in the posterior areas; however, the tissues had a healthy texture and tonus.

Fig. 6.—Maxillary implant after three months. No significant changes were noted, even though slight debris was present around the posts.

*The microscopic sections were interpreted by Joseph M. Young, M.D., Chief, Laboratory Service, Kennedy Veterans Hospital, Memphis, Tennessee.

Fig. 7.—Photomicrograph of soft tissue adjacent to post extending into oral cavity. A minimal amount of inflammatory reaction is seen in the region where the squamous epithelium turns the corner to go down alongside the post. (Hematoxylin and eosin stain. Magnification, ×3.2 × 10.)

epithelial hyperplasia were present, and there was moderate condensation of the connective tissues in the regions of the posts. This tissue contained a few polymorphonuclear leukocytes. An inflammatory cell infiltration of chronic nature was noted in the tissues deep to the posts; in the tissues nearer the

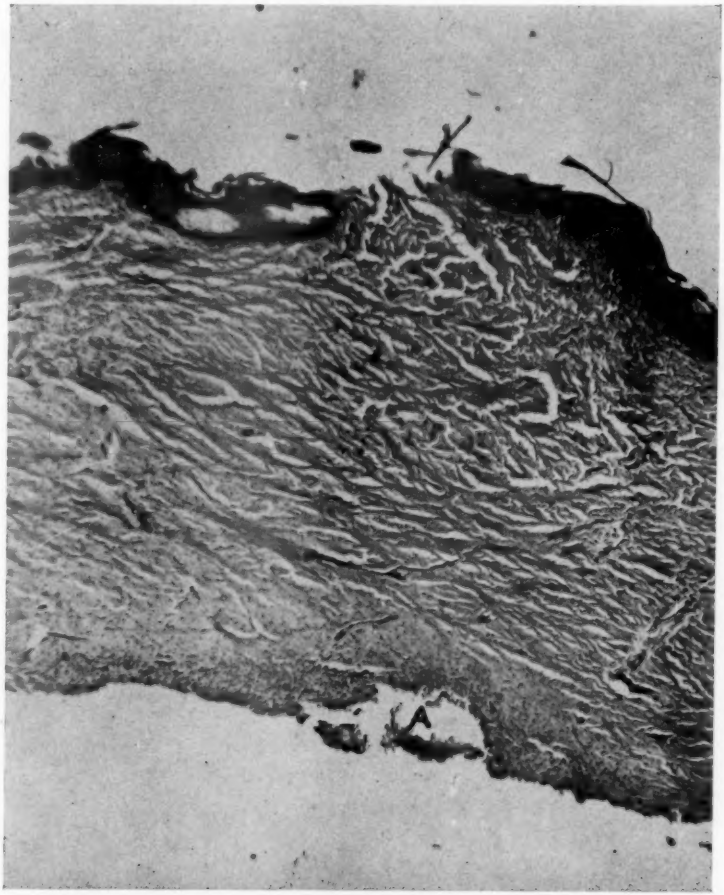


Fig. 8.—Photomicrograph of soft tissues around the circumferential wire used with the mandibular implant. There is slight condensation of the connective tissue, and this is represented as a fairly hyaline scar. Along this area are a few bits of black particulate material believed to be products of corrosion from the wire. No foreign body reaction is seen in any portion. *A*, Wire site. (Hematoxylin and eosin stain. Magnification, ×3.2 × 10.)

posts the inflammation was more acute. Where least involved the tissues showed moderately dense fibrosis, and where most involved they showed the appearance of granulation tissue (although this was not excessive). No foreign-body reaction was seen. In all areas adjacent to the posts there was minimal

chronic inflammatory cell infiltration along with the scarring, which signified nothing more than scattered areas of chronic inflammatory reaction.

Sections that included periosteum and bone revealed the cortical layer to be intact, and in areas of the implant a moderate amount of hyaline fibrous tissue lay over the bone. In a few areas there was some fibrous replacement

Fig. 9.—Photomicrograph of soft tissue and bone with a space between which was occupied by the implant. The soft tissues overlying the region of the implant show condensation. There is a slight chronic inflammatory-cell infiltration of the tissues. No significant new bone formation is demonstrable, and no foreign body reaction is present. (Hematoxylin and eosin stain. Magnification, ×3.2 × 10.)

of marrow, but this still had a relatively usual component of connective tissue cells. No significant new bone formation was present.

Careful dissection was done in the regions of the tantalum screws and stainless steel wires in an attempt to gain evidence of galvanic action to the Vitallium implants. The screw tract through the vomer was partly lined by a thin layer of fibrous tissue. Along this tract, in a few areas, there was minimal proliferation of osteoid tissue. In the regions of the wires, slight condensation of the connective tissue was represented as a fairly hyaline scar. A small amount of particulate, black material was seen in the connective tissue about the wires. This was believed to consist of products of corrosion from the wires. Foreign-body reaction to the screws and wires was not demonstrable in either bone or soft tissues.

## SUMMARY

Two Vitallium oral implants were placed subperiosteally and maintained satisfactorily for three months. This was accomplished by extracting the premolar teeth, taking direct bone impressions of the healed ridges, and casting the framework from models of the impressions. The implants were mechanically secured, and great care was taken to coapt the tissues over the framework and about the posts.

At the end of the three-month period, the gross appearance indicated no significant change in the oral tissues. The implants remained firmly in place, and the animals seemed to be totally unaffected by their presence. Specimens from the regions were taken for sectioning and microscopic examination. There were areas of slight to moderate chronic inflammatory reaction, some scarring, and fibrous formation; this was seen mostly in the tissues near the posts. The epithelium grew downward alongside the posts for only a short distance and disappeared. No foreign-body reaction was observed. Overlying some of the bone, in areas of the implant, was a moderate amount of hyaline fibrous tissue, and there was fibrous replacement of the marrow in isolated areas of bone. There was no notable new bone formation. No evidence of reaction to the possible galvanic current between the Vitallium and the tantalum could be demonstrated within the time of this study.

## CONCLUSION

The results of this research on oral tissues subjected to Vitallium implants for three months indicate the following:

1. There is no significantly adverse reaction of the soft tissues or bone to a Vitallium implant, even when it is exposed directly to the oral cavity. Therefore, if care is taken to gain close adaptation of the tissues about the projecting posts, there is an epithelial downgrowth which simulates that seen in the sulcus about a natural tooth.

2. There is no notable reaction of bone from pressure brought to bear by a Vitallium implant mechanically secured.

3. There is no reaction to the possible galvanic current between the alloys, tantalum and Vitallium, or between stainless steel and Vitallium when they are in contact within the living tissues of dogs.

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# THE UNUSUAL OCCURRENCE OF A LARGE SUBLINGUAL NEURILEMMOMA

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A NEURILEMMOMA is characteristically an encapsulated, benign tumor of nerve sheath origin arising in cranial, sympathetic, and peripheral nerves. Although it may arise from any nerve possessing a sheath of Schwann and is a relatively common tumor, reports of neurilemmoma of the oral cavity are relatively rare. Actually the greatest majority of such tumors reported have been in the cheek and tongue, and most of them have been small in size. We are adding a case to the present small list of oral neurilemmomas. This particular case is of considerable interest not only because of the tumor's location but also because of its large size.

## CASE REPORT

A 20-year-old Negro trainee was referred to the oral surgery service at Fort Leonard Wood, Missouri, because of a mass in the floor of his mouth. He claimed that he had been unaware of the existence of the mass until it was pointed out to him by a medical officer during a routine physical examination. Upon further questioning, however, he admitted that he had noticed slight difficulty in swallowing and speech over the past two or three months. He had no other complaints.

The past medical history was negative, except for a tonsillectomy that was performed when the patient was 8 years old. There was no history of a similar complaint in the patient's family. A review of systems was essentially negative except for the present illness.

On physical examination, a large mass was found in the floor of the mouth, directly in the midline. The mass was perfectly symmetrical, rubbery in consistency, nonfixed, nontender, and easily palpable bimanually. Clinically, it appeared to be about the size of a hen's egg. The overlying mucosa was normal in color and consistency but under tension from the mass, which left the small mucosal vessels in clear relief against the pale, yellowish white background. Wharton's ducts were patent, and a clear, serous fluid was easily expressed from both orifices. The mass moved with the tongue, which was constantly elevated but in the midline. A slight submental tumescence was visible extraorally, also in the midline. Attempted aspiration with an 18 gauge needle yielded nothing. The mass appeared to be situated above the mylohyoid muscle. Routine roentgenograms of the mandible and an occlusal dental film revealed no abnormal hard tissues. A routine hemogram and urinalysis were within normal limits. The preoperative diagnosis was sublingual dermoid.

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*Operation.*—On the morning of April 15, 1957, the patient was given the usual premedication and taken to the operating room. Anesthesia was induced with endotracheal (nasal) nitrous-oxide and oxygen and 2 per cent Pentothal sodium supplemented by a 0.1 per cent Anectine drip. Considerable difficulty was encountered when the intubation was attempted, and the anesthetist stated that the epiglottis was deviated to the right. Most of this difficulty, of course, was caused by the large bulk of the sublingual mass which virtually prevented exposure of the cords.

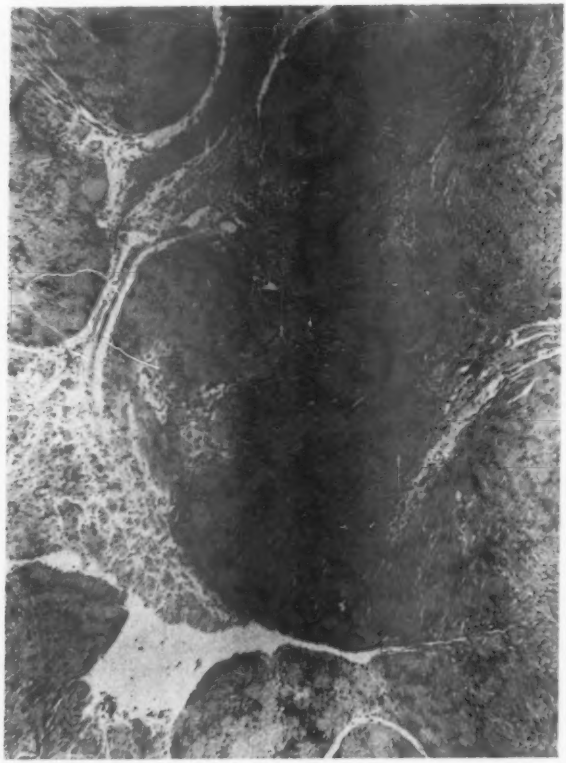

Fig. 1.—Low-power view of the tumor demonstrating large masses of the characteristic Antoni A substance thinly separated by scanty fibrillar tissue (Antoni B substance).

The patient, placed in a supine position on the operating table, was prepared and draped in the usual sterile manner. A 00 black silk suture was placed through the apex of the tongue for purposes of retraction. A midline incision was made, beginning from the lingual frenum's attachment to the mandibular alveolar ridge and extending dorsally to the termination of its attachment to the tongue, care being taken to avoid the orifices of Wharton's ducts. By a combination of sharp and blunt dissection, the superficial fibers of the genioglossus muscle were divided and the surface of the mass was exposed. The many fine, fibrous strands attached to the mass from its bed were severed with dissection scissors, and it soon appeared that the mass was larger than originally suspected and that it extended well beneath the tongue to its root. In view of this, the rest of the mass was

separated from its bed by blunt finger dissection, there being rather tough, fibrous attachments in the midline on the ventral surface. The mass was delivered cleanly from the wound by means of a traction suture placed earlier through its anterior pole for control purposes. Two smaller but similar-appearing masses were thereby exposed, and these were also removed. This left the bed of the wound grossly clean, with the fibers of the genioglossus and geniohyoid muscles bisected as a result of the location of the tumor and the midline area of the mylohyoid muscle exposed in its lowermost portion.

Fig. 2.—High-power view of one of the large masses of Antoni A substance demonstrating the prominent palisading of nuclei and alignment of Schwann cells.

The muscles were closed in layers with 000 chromic catgut sutures, and the mucosa was closed with interrupted 0000 plain catgut sutures. The patient tolerated the procedure well, and blood loss was minimal since no significant vessels had been encountered.

Convalescence was essentially uneventful, except for the expected sore throat due to intubation difficulties and the edema of the floor of the mouth and the tongue.

*Pathologic Examination.*—The mass was submitted in three portions. The larger portion was fusiform to roughly "football-shaped and measured 7 by 4 by 3 cm. This mass was externally smooth, although it possessed several slightly raised, multilobulated excrescences; it was firm and yellow. The cut surface revealed a solid, rubbery, homogeneous, yellow tissue. The two smaller portions, which measured 3 by 2 by 1 cm. and 2 by 2 by 0.5 cm., respectively, were likewise rounded masses and identical in appearance to the greater portion.

Multiple representative sections were examined microscopically after routine hematoxylin and eosin staining. These revealed a similar pattern throughout, as shown in Figs. 1 and 2. The tumor was composed of two distinct types of neurogenous tissue. The predominant type consisted of twisted, compact, and (in areas) hyalinized masses of whorled and interlacing spindle cells. These cells were arranged in paralleling rows and bundles with marked alignment or palisading of nuclei. This type of tissue simulated an accentuated Verocay body and was termed Antoni A substance. Separating these areas of Antoni A substance were loose, edematous, fibrillar, neurogenous-appearing spindle cells. These cells were arranged in a loose, somewhat disorderly appearance and represented Antoni B substance. A well-demarcated, hyalinized, fibrous tissue made up the capsule of the tumor.

*Diagnosis:* Neurilemmoma, floor of mouth.

SUMMARY

A case of an unusually large neurilemmoma in the floor of the mouth has been reported. Neurilemmomas in this region are most uncommon. To our knowledge, a neurilemmoma of this size has not previously been reported in this location. Another unusual feature of this case was the paucity of clinical symptoms.

# EXODONTIA

## TOOTH EXTRACTION IN PATIENTS WITH HEMOPHILIA

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THIS article owes its origin to two main factors. The first of these was the establishment in 1955 of a register of all the hemophiliacs in Northern Ireland. The epidemiology, laboratory findings, and other aspects have already been reported.[1] To date a total of fifty-one cases have been found in Northern Ireland in a fairly stable population of $1.40 \times 10.^6$ Forty-seven of these are cases of classical hemophilia (hemophilia A), which gives an approximate incidence of 1 in 30,000 for this form. Only four cases of Christmas disease (hemophilia B) have been found, and no cases of hemophilia C have been detected as yet.

The second factor was the introduction of a special service of regular dental inspection and treatment of all the hemophiliacs on our register, in which private practitioners play an essential part.[2] A number of these persons required tooth extraction and were referred to The Royal Victoria Hospital for inpatient treatment. The arrest of hemorrhage from a tooth socket in patients with hemophilia presents a formidable problem and, although treatment of the basic clotting defect rests with the hematologist, the dental surgeon has a definite part to play in controlling the blood loss. Our observations in relation to this factor and our general approach to treatment are presented in the discussion that follows.

### SUBJECTS

In the present series of fifteen patients, fourteen suffered from hemophilia A (classical hemophilia) and one suffered from hemophilia B (Christmas disease). Five of the patients with classical hemophilia had a severe form of the disease as judged by the degree of reduction of the specific clotting factor in their blood and their clinical manifestations, four had a moderate form, and six had only a mild form of the disease.

From the Dental Department, The Queen's University of Belfast, and the Clinical Pathological Laboratory, The Royal Victoria Hospital, Belfast, Northern Ireland.

Twenty-three dental operations were performed on these patients, and a total of forty-seven teeth were extracted.

Except for one mild case (Case 9) all patients were admitted to the hospital and initially confined to bed. However, moderate activity was encouraged as soon as possible.

### SYSTEMIC MEASURES

Transfusion forms the fundamental approach to the treatment of post-extraction hemorrhage in all three types of hemophilia. In classical hemophilia (hemophilia A) the deficient factor, antihemophilic globulin (AHG), is present only in fresh plasma or blood. In Christmas disease (hemophilia B) the deficient factor is present in serum and in fresh or stored plasma. These points must be borne in mind when replacement therapy is being planned. It has been found that in classical hemophilia bleeding is unlikely to occur if the level of AHG is maintained consistently above 10 per cent of normal. Therefore, in patients in whom the AHG level was lower than 10 per cent we always attempted to raise the AHG to this hemostatic level by fresh plasma transfusion immediately prior to operation.

The volume of plasma required to raise the hemostatic level from approximately 1 per cent to 10 per cent is of the order of 1 liter. This volume of plasma was therefore given an hour before operation, the speed of transfusion being such that the whole liter was injected within thirty to forty-five minutes. Because of the short survival of AHG when transfused into the circulation (half-life approximately twelve hours), it was considered necessary to transfuse a further liter of plasma twenty-four hours after operation. Further plasma transfusions were not given routinely unless there was severe bleeding which failed to respond to local hemostatic measures. If oozing from the tooth socket became persistent, it was considered important not to delay plasma transfusions since, in addition to depleting the antihemophilic factor level, continued hemorrhage is known to retard healing processes. Replacement transfusion with fresh whole blood was used when hemorrhage was excessive or when the hemoglobin level had fallen. If the blood loss was sufficient to cause iron depletion, oral iron was given in standard dosage and continued after the patient's discharge from the hospital until normal hemoglobin levels were reached.

Only one case of mild Christmas disease is included in the present series. This patient received 500 ml. of stored plasma prior to operation, and no post-operative bleeding occurred. In this case, control of hemorrhage was not a major problem. McIntyre and colleagues[3] after experience with dental extractions in nine cases of Christmas disease, present evidence which supports the view that hemorrhage in Christmas disease is more easily controlled than hemorrhage in classical hemophilia.

As hemophilia is mainly a coagulation-factor deficiency and not a capillary abnormality, the use of such substances as adrenochrome monosemicarbozone dihydrate (Adrenoxyl), which decrease capillary permeability and increase contractility of the vessels, is of no value.

Vitamin K has been advocated by Stones[4] for treatment of postextraction hemorrhage in patients with hemophilia. It is difficult to see the rationale of such treatment, as in hemophilia the prothrombin level is always normal. Vitamin K substances are of value only in coagulation defects that are caused by a fall in the plasma prothrombin level, which may occur, for example, in liver damage or anticoagulant therapy.

### CONTROL OF INFECTION

Secondary hemorrhage from a tooth socket may be stimulated by infection. Therefore, dental extraction was never performed in the presence of gross sepsis. In general, we employed antibiotic cover by an oral rather than a parenteral route because of the danger of hematoma formation at the injection site. For this purpose, phenoxymethyl penicillin in doses of 240 mg. every six hours was given routinely to every patient on the day before operation and was continued for five days thereafter.

### ANESTHESIA

Thirteen of the patients represented in the present article were operated on under endotracheal anesthesia administered by means of a nasal tube and a pharyngeal pack. Nasal hemorrhage was noted in Case 12 on removal of the rubber endotracheal tube, and spontaneous hemostasis occurred within half an hour. To avoid this complication, oral intubation with an armored tube has been advocated by Leatherdale.[5] This approach limits the operative field, however, and in our experience was unnecessary.

Nitrous oxide anesthesia without intubation was used successfully in three patients (Case 6A and B, 4C and 15). This method was not considered ideal, as full relaxation is difficult to maintain and there is a consequent danger of self-inflicted trauma during the excitement phase.

Local anesthesia may also be employed successfully. McIntyre and associates[3] report the use of local anesthesia in the majority of the eighty-one dental operations which they performed on fifty-eight hemophilia patients. In our series local anesthesia was used for tooth extraction in only one "mild" case (Case 9) and no difficulty was encountered. However, this would appear to have greater attendant dangers than general anesthesia. Archer[6] records a case in which the patient died of asphyxia due to cervical hematoma within forty-eight hours after receiving two inferior alveolar injections of local anesthetic for cavity preparation. Orr and Douglas[7] found that regional inferior dental blocks carried the risk of a cervical hematoma, and McIntyre and colleagues[3] record a case of persistent inferior dental anesthesia, possibly due to a perineural hematoma following the use of a regional block.

With due regard for the specific dangers of each method, it would appear that general anesthesia carries less risk, although local anesthesia is practicable. Premedication is to be advocated in all methods. If necessary, this may be coupled with postoperative sedation, although this was not required in any of our patients.

EXTRACTION

The natural exfoliation of teeth and roots in patients with extreme neglect should be accepted. Of the fifty-one hemophiliacs in Northern Ireland, one was edentulous and in ten others with severe neglect natural exfoliation was accepted. In the remaining cases, except for deciduous teeth, full conservative measures are being employed.

Birch and Snider[8] and Nichols and Baldridge[9] have advocated accelerating natural exfoliation by applying an elastic band to conical single-root forms four weeks prior to extraction. Because of the inclined surfaces of the tooth, the elastic band tends to roll apically and irritate the epithelial attachment. However, Archer[6] and White and Mallet[10] found this method to be of only limited value, and it has not been used in the present series as the majority of patients complained of acute pain.

TABLE I. MEAN FINDINGS IN FORTY-NINE CASES OF HEMOPHILIA*

| SPLINTS | TOTAL NUMBER OF OPERATIONS | | MEAN PER OPERATION: TEETH REMOVED | DAYS OF BLEEDING | PINTS PLASMA | PINTS BLOOD |
|---|---|---|---|---|---|---|
| None | A* | 5 | 5.8 | 7.0 | 4.2 | 0.01 |
| | B | 7 | 2.1 | 8.3 | 1.1 | 4.57 |
| | C | 3 | 2.7 | 8.0 | 7.6 | 0.50 |
| | Pooled means | | 3.5 | 7.8 | 4.3 | 1.69 |
| Removable | A | 7 | 5.9 | 12.0 | 4.5 | 0.14 |
| | B | 25 | 1.7 | 5.6 | 2.3 | 0.04 |
| Removable and fixed | C | 13 | 1.8 | 4.3 | 2.6 | 0.25 |
| Fixed | C | 7 | 2.3 | 1.5 | 3.1 | 0.39 |
| | Pooled means | | 3.2 | 6.9 | 3.2 | 0.16 |
| Removable | D | 34 | 4.3 | 4.5 | 3.6 | 0.97 |
| | Pooled means A, B, C, and D | | 3.5 | 6.3 | 3.3 | 0.36 |

*A = Eight cases reported by Matheson.[12]
B = Ten cases reported by Orr and Douglas.[7]
C = Fifteen cases covered in the present report.
D = Sixteen cases reported by Wishart and associates.[11]

The number of teeth and roots that can be extracted in a single operation depends upon their location, the severity of the disease (that is, the AHG level) and the hematologist's previous experience in treating the particular patient under consideration. It is wrong to assume that replacement therapy can control bleeding from ten or more extractions as effectively as from one extraction. The larger the area of fresh clot exposed, the greater the chance that normal hazards will cause its displacement and resulting continuance of the hemorrhage. To support this observation, Orr and Douglas[7] have shown that the drop in hemoglobin levels is directly related to the number of teeth extracted, and they advise the removal of no more than two teeth per operation. Wishart and coworkers,[11] however, have extracted up to eighteen teeth in one operation. The latter state that, although hemoglobin levels may be related to the number of extractions, the danger period during which bleeding is likely to occur is not.

McIntyre and associates[3] also adopt this view and have removed twenty-five teeth in one operation. In contrast, however, they present figures to show that multiple extractions of deciduous teeth do prolong bleeding.

We have found that the wisest course is to extract no more than eight teeth (in adjoining sites, if possible) in a mild case and no more than four teeth in a moderate or severe case.

The extraction should be performed with a minimum of trauma to the surrounding tissues. Buccal alveolectomy to reduce the area of the clot is not advocated[12]; nor should a cautery or diathermy be used, because of the eventual slough of the coagulated tissue with possible secondary hemorrhage.

The mortality following dental extraction in hemophiliacs is negligible. No fatalities occurred in the present series, in the series of three other investigators shown in Table I, or in the series of McIntyre and associates.[3] Thus, in a total of 107 treated cases, not one death occurred.

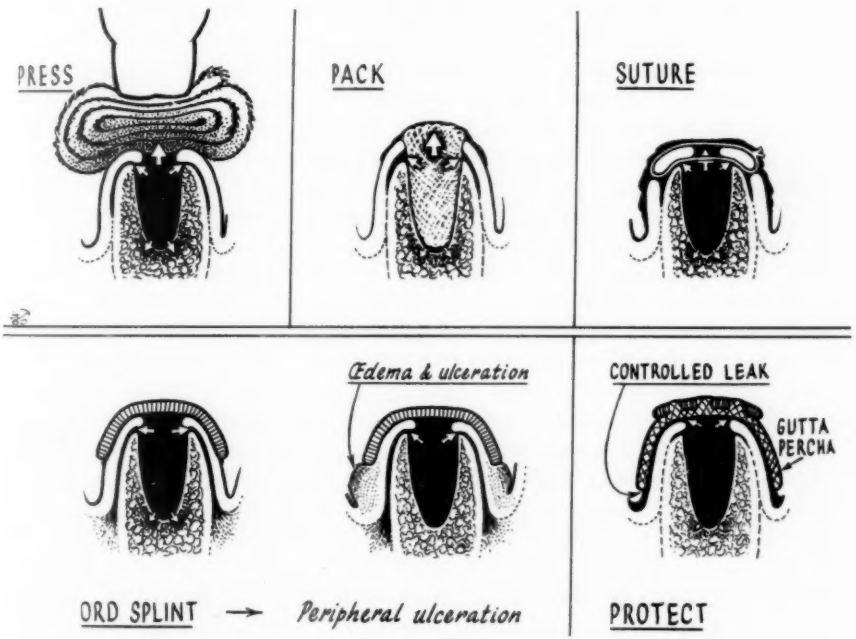


Fig. 1.—The mechanical methods of controlling hemorrhage from a tooth socket.

LOCAL MEASURES

There are four methods which mechanically aid the local arrest of hemorrhage from a tooth socket—pressing, packing, suturing, and protecting. These measures may be used singly or in combination, with or without a vasoconstrictor or a coagulant (Fig. 1).

*Pressing.*—A number of authors recommend that gauze swabs be applied with pressure over the socket. These swabs may be either dry or moistened with saline, Adrenalin, tannic acid, or thrombin. The pressure can be applied by the patient's own effort, by wiring the upper and lower jaws together, or by a head bandage as advocated by Archer.[6] For multiple extractions, Nichols and Baldridge[9] recommend that alternate teeth be removed and that a rolled gauze swab be wedged between the remaining teeth to obtain adequate pressure on the socket.

In emergencies, we use a rolled gauze swab covered with polythene or moistened cellophane which maintains pressure without absorbing the clot. Another approach, advocated by Matheson,[12] is the use of a piece of dental impression compound which is molded over the socket area, muscle-trimmed, and retained between the patient's teeth.

Ice bags and ice cubes in association with pressure were used in Case 1 and found to be of no definite value. Hot saline pressure swabs, however, were found to be of value in the arrest of the immediate postextraction hemorrhage in the majority of cases.

In general, we consider these methods to be inefficient and temporary, aside from the danger that the hematoma may be directed into the facial, cervical, and thoracic tissues.

*Packing.*—The obliteration of the "dead space" of the socket with nonabsorbable material has some initial value, as it applies pressure to the vessels of the socket. Since the socket walls are conical, however, the clot tends to dislodge the pack orally. Furthermore, if the pack does remain, it has to be removed at some point and the friction caused by this movement may precipitate further bleeding. Mead[13] advocates packing a socket with gauze saturated with tannic acid solution and after forty-eight hours gradually removing it over a period of an additional forty-eight hours; thus, the pack is changed every four days.

Archer[6] recommends the use of iodoform gauze soaked in 1:1,000 epinephrine and tannic acid crystals. Blair and Ivy[14] also advise this method, but they add that oxidized gauze and cotton has the advantage of gradual disintegration and need not be removed. Matheson[12] uses Whitehead's varnish (Pigmentum Iodoform Co.B.P.) on gauze or cotton wool to pack and seal the socket. To avoid pressure, Dennison and Thomson[15] have placed a small piece of gauze soaked in Russell's viper venom over the orifice of the socket, but they conclude that local coagulants are of only small value. The use of bone wax for occluding small vessels in alveolar bone is advocated by Blair and Ivy,[14] but this method cannot be effectively applied to the walls of a tooth socket.

Obliteration of the socket with absorbable material, such as fibrin foam, oxidized cellulose gauze, and calcium alginate, is of value in that the material does not have to be removed. Coagulation is initiated by soaking these materials in "dilute" thrombin, that is, 100 units per milliliter, as more concentrated solutions of thrombin cause lysis of the clot.[16]

Hardisty[17] records the successful use of this type of pack alone in a 22-year-old woman with Christmas disease (hemophilia B) who was studied following repeated postextraction hemorrhage.

Archer[6] advocates the use of purified gelatin (Gelfoam) soaked in thrombin and supports the findings of Guralnick[18] concerning its efficiency in these cases in both arresting hemorrhage and accelerating healing. Gelfoam's action is recorded as being superior to fibrin foam, and it is completely absorbed in six weeks.

White and Mallet[10] suggest oxidized cellulose (Oxycel), and Orr and Douglas[7] favor calcium alginate (Calgitex) or fibrin foam soaked in thrombin and retained in position by a dental splint.

In the present series, absorbable packs (Calgitex) were used in Cases 1C, 2A, and 2B, and no definite advantage can be attributed to their use.

*Suturing.*—Suturing a tooth socket in a hemophilia patient is of small value, and it may be dangerous. The additional punctures provide further bleeding points which are likely to be reopened when the area is disturbed by removal of the suture. Furthermore, confining the hemorrhage within the tissues produces a hematoma which tends to strip fresh areas of periosteum away from the bone and increase the hemorrhage. If the sutures are inserted with tension, as advocated by Mead,[13] then pressure necrosis is likely to occur, with an unpleasant secondary hemorrhage involving the palatal or buccal mucosa where it may be difficult to apply local measures. Conversely, the suture might be too effective and cause a severe and maybe fatal hematoma, as reported by Qvist and colleagues.[19] If a suture is necessary because of laceration of the mucosa during extraction (Cases 18, 3, and 10 of our series), then 000 quick-absorption catgut should be used with a minimum of tension. Even this approach, however, may cause a secondary hemorrhage, as recorded by Moss.[20]

*Protecting.*—The aim of local treatment is to control the blood loss. The foregoing treatments either invade the socket space or increase the intrasocket pressure and thus tend to drive the hemorrhage into surrounding tissues. We must not overlook the fact that when the coagulation defect is temporarily remedied by transfusions, a clot will undoubtedly form. This clot is of an extremely friable nature, however, and any normal function, such as swallowing, eating, or vomiting, will dislodge it and precipitate further bleeding. Therefore, the correct local approach is to avoid pressure and to protect the clot. In patients who have a suitable number of teeth, this clot may be protected by a removable or fixed dental splint.

Removable acrylic appliances are recommended by White and Mallet[10] and by Wishart and co-workers,[11] who combine protection with slight pressure.

Orr and Douglas[7] also advocate the use of removable appliances, but they line the socket area with black gutta-percha and emphasize that their main aim is to protect the clot. Archer,[6] however, considers these appliances to be of small value as (1) they tend to become displaced by the clot, (2) they impinge on the gingival tissues, and (3) they require removal and cleansing every six to twelve hours.

Dalitsch[21] advocated the use of a close-fitting vulcanite splint ligatured into position and left undisturbed for ten to fourteen days.

Vulcanite or acrylic "hemorrhage plates" cemented into position with a zinc oxide and eugenol paste are favored by Matheson.[12] Dennison and Thomson,[15] in treating a series of ten children, used fixed acrylic cap splints cemented into position with a resinous zinc oxide and eugenol paste. They also emphasize the importance of protecting the blood clot. On the other hand, McIntyre and associates[3] found that a zinc oxide and eugenol paste hindered removal of the splint, and they subsequently did not use a cementing medium. Their method was to use a removable clear acrylic splint with an external head harness to maintain oral closure.

In edentulous patients with mild hemophilia the clot may be protected by the insertion of immediate dentures lined with a mixture of thrombin powder and gum tragacanth and by the use of a jaw bandage to minimize movement. In severe cases, Wishart and associates[11] advocate, for upper teeth, a splint (Gunning[22]) fixed by extension bars to a plaster headcap and, for lower teeth, a splint fixed to the upper appliance by springs.

In the present study variations of the foregoing appliances have been adopted and are reported.

## METHOD OF PROTECTION

Three types of tooth-borne splint (removable, semifixed, and fixed) were used in the present series. No edentulous splints were constructed.

1. *Removable Acrylic Splint.*—The technique of construction of these appliances was similar to that described by Wishart and colleagues.[11] Briefly, it consisted of a clear acrylic splint denture, with special wire clasps (Adams[23]). The socket area was covered with an acrylic "saddle" which had been designed to exert a slight pressure. In general, the design was that of an "overlay" denture, in which as much of the appliance as possible was tooth-borne. No complications of the impression technique, such as a pharyngeal hematoma,[21] were noted.

2. *Semifixed Acrylic Splint.*—This consisted of a "removable" splint, without clasps, which was cemented into position with a resinous zinc oxide and eugenol paste.

3. *Fixed Splints.*—Several types are available.

*Fixed acrylic splint:* This consisted of an acrylic splint which covered the teeth labially and lingually and, in the socket area, extended to the "natural" muscle-trimmed area. It was cemented into position with zinc oxyphosphate cement.

*Fixed silver "cap" splint with socket area lined with black gutta-percha:* The cap splint covered as many teeth as possible, so that a good articulation could be obtained. Thus, upper and lower alginate impressions and wax bite were taken, and the models were cast and assembled on a "plane" line articulator. The design of the splint in the socket area was such that the silver was 5 to 10 mm. short of the "natural" saddle perimeter on a good muscle-trimmed

impression. When the gutta-percha was applied, it extended the saddle to the natural perimeter and 3 to 4 mm. over the adjacent teeth. The clearance allowed between the silver and the model in the socket area was 2 mm., or one thickness of base plate. If the alveolus was markedly undercut, then it was carefully blocked out with plaster, or the wax pattern was pumped during its application. The tooth was carved off the model, but no extra carving indicating alveolectomy was done. The pattern was next sprued and invested in the accepted manner. After trimming and polishing, the splint was set back on the master model and checked for fit and occlusion. Next, the socket area was perforated with a number of holes, 3 mm. in diameter, to provide an attachment area for the gutta-percha. The model was then dusted with French chalk, and the gutta-percha was softened and applied firmly to the saddle area. The collar-stud portions which were squeezed through the saddle perforations were sealed with a hot wax knife. The splint was then removed and washed in an antiseptic detergent.

Next, the tooth was removed under suitable anesthesia, and the patient's remaining teeth were dried with gauze swabs. The gutta-percha in the socket area was then heated in a flame and slightly softened. During this period a liberal mix of a copper germicidal cement was prepared by an assistant and inserted into the dentate portion of the splint. The gauze swabs were then removed and the splint was inserted, care being taken to avoid distorting the socket mucosa. The splint was held in position for at least four minutes. Next, the mouth was gently swabbed and sucked clean so as to avoid any danger of inhalation of cement particles.

An absolute seal of the socket mouth with immediate cessation of visible hemorrhage was not always obtained. This was a desirable feature of the appliance, as a slight leakage counteracted any tendency of the splint to direct bleeding into the surrounding tissues.

The splint was removed in five to ten days by levering the buccal flange of the splint outward by means of a pair of upper straight forceps, one blade on the splint edge and one on the occlusal surface, like a bottle opener. Extreme care was taken to avoid damaging the gingiva. If the patient is particularly apprehensive, the procedure can be safely carried out under nitrous oxide analgesia, although this approach was not necessary in any cases in the present series. The copper cement was removed by careful scaling and brushing of the teeth. This was not the hazardous process that might be expected, as spontaneous gingival hemorrhage is not a feature of this disease.[24] Only one patient (Case 5) in the present series had a spontaneous hemorrhage of a mild character, and this proved to be in association with an acute marginal gingivitis. Two other patients (Cases 7 and 8) gave a history of intermittent oral hemorrhage, and in these cases the sharp edges of carious deciduous teeth had caused traumatic abrasions of the dorsum and lateral border of the tongue.

### RESULTS OF PROTECTION

*Removable and Semifixed Splints.*—Hemorrhage continued in Cases 2A and 4B for fourteen days.

Slight facial hematomas occurred in Cases 2A and 3, slight mucosal ulceration occurred in Cases 2, 3, 4A, 4B, and 5. In Cases 2, 3, 4A, 4B, 5A, and 8, the splint was loose, and in Cases 3 and 5 the splints tended to aggravate bleeding and were discarded on the third postoperative day. In Case 4A local action was necessary to control the blood loss, and after the clot had been trimmed the splint was cemented into position with a zinc oxide and eugenol resinous paste. Some measure of success was obtained by this approach, and Cases 10 and 2B were successfully treated in this manner from the time of extraction.

*Fixed Splints.—*

*Acrylic splint:* In Case 11 there was no hemorrhage until the seventh day when, due to pressure of the edema against the buccal flange of the socket area, ulceration and secondary hemorrhage occurred. The splint was removed, and gauze swabs soaked in thrombin were placed gently over the area. A transfusion of 500 ml. of blood was given, and hemostasis was achieved in about four hours.

*Silver splint with the socket area lined with gutta-percha:* The patients were ambulant on the day after the operation and on the second or third day were started on a normal hospital diet.

In Cases 5B and C, however, during the single hospitalization, the patient had a lower right molar removed with no postoperative bleeding. Seven days later it was decided to remove an upper left molar, and exactly the same procedure was followed as with the first operation. For ten days there was no hemorrhage, but on the tenth day it was noticed that the buccal mucosa in association with the perimeter of the splint was slightly edematous and soggy. In view of this factor, it was decided not to remove the splint as planned. The patient, however, wished to return home for three days, and this was allowed. While waiting for transport, however, a sudden severe hemorrhage occurred from the buccal area, and the patient was readmitted to the hospital. Transfusion was instigated, and that night the splint was removed and thrombin-soaked gauze swabs were applied. The hemorrhage continued unabated until the following evening, when it was felt that some further local measures should be attempted. Consequently, the gutta-percha flange of the splint, which had been constructed to avoid the curvature of the zygomatic-maxillary buttress, was extended over the ulcerated area to reach the sulcus. The splint was then recemented into position, and there was an immediate marked decrease in the bleeding, with complete cessation within an hour. Further progress was uneventful; the splint was finally removed four days after application, and normal healing was observed. Despite this episode, however, the number of days of bleeding had been reduced when compared to the results of using a removable splint (Case 5A) in the same patient.

In one other case (Case 12) a mild edematous reaction occurred in relation to the buccal and palatal perimeter of the splint. On removal of the appliance on the tenth day, a slight ooze resulted which continued for approximately six hours. No treatment was given.

Another patient (Case 4C), who had been admitted to the hospital with intestinal hemorrhage and hemarthroses of the wrist and knee, developed an

acute pulpitis in a grossly carious upper left molar. He also had a carious upper right second premolar and some retained upper right first molar roots. It was decided to remove these teeth under nitrous oxide anesthesia, as the patient had had a mild epistaxis on the evening prior to operation. The operation was completed successfully, and a fixed silver splint was cemented into position. Oozing, mainly from the left side, continued intermittently until the evening of the seventh day, when it became dramatically worse. Transfusion arrested the bleeding temporarily on the eighth day. The source of the hemorrhage appeared to be edematous buccal mucosa in the region of the maxillary buttress, associated with the periphery of the flange. The splint was removed, and the source of the hemorrhage was confirmed. The gutta-percha lining was replaced by an adhesive soft acrylic lining of the same area. The splint was then recemented and the hemorrhage was arrested. On the ninth day, however, the hemorrhage had resumed in a severe form, and the source now appeared to be palatal. Gutta-percha was applied over the plastic, and temporary arrest was effected. Finally, the splint was removed once more and the source of bleeding was now found to be the midpoint of the palatal gingival mucosa. The soft acrylic was removed and replaced with gutta-percha which extended to the midline palatally and the alveolar reflection buccally. The splint was recemented, with immediate cessation of hemorrhage. Further progress was uneventful, and the splint was removed five days later. An edematous welt indicating the periphery of the original splint was still visible palatally (Fig. 2); otherwise, normal organization of the clot was taking place.

Fig. 2.—The appearance of the buccal and palatal tissues immediately after removal of the silver cap splint in Case 12. Note the raised area in asociation with the periphery of the splint. The black appearance of the teeth is caused by remnants of black copper cement.

## EVALUATION OF THE PROTECTION TECHNIQUE

From the results of protection shown in this article and from an analysis of the results reported in four other papers (Table I), it can be seen that, whatever the design, splints reduce bleeding from an average of 7.8 days to an average of 6.3 days. These investigations, which all advocate splints, represent the combined observations of teams of hematologists and dental surgeons. In

the present work all types of splints have been used and a fixed silver splint which reduces bleeding to an average of 1.5 days, is advocated. However, all findings must be examined with respect to the number of extractions per operation and the individual disease severity in each group, and on such small numbers this is extremely difficult to evaluate.

However, the use of this type of splint enabled even patients with severe hemophilia to have an almost normal diet on the second or third day, which is in contrast to the fluid diet regime advocated with removable splints by McIntyre and co-workers.[3] The over-all improvement in the patient's morale is one of the most gratifying aspects of this treatment. The time spent in the hospital has been slightly reduced from 10.7 days to nine days. However, bleeding may occur at any time within this period and depends upon the severity of the case and the effectiveness of the splint.

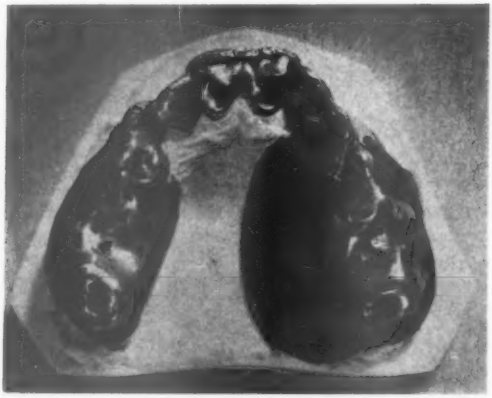

Fig. 3.—The final appearance of the splint used in Case 4C.

Matheson,[12] using removable splints, shows an average bleeding period of twelve days. In the present series, however, the average for this type of splint was 4.3 days.

One of the characteristic features of socket healing in the patient with hemophilia, which has also been noted by Nichols and Baldridge,[9] is the venous and edematous appearance of the adjacent mucosa. This reaction in association with a removable or semifixed appliance can be attributed to trauma from the compressive movements of mastication, but when it occurs with a fixed appliance it must be associated with a tissue reaction. It was most marked between the seventh and tenth days and may be accounted for partly on physiologic grounds and partly by a vascular defect which Miale[25] suggests may exist in hemophilia. To minimize this edematous reaction, the black gutta-percha lining advocated by Orr and Douglas[7] was adapted to the fixed technique presented in this article in the hope that at body temperature the gutta-percha would tend to be molded to the edematous tissues. This was not proved in the present study,

however, as underextension of the gutta-percha produced ulceration. The main value of gutta-percha was that it was well tolerated by the tissues and also that it was easily manipulated. The use of a soft acrylic lining instead of gutta-percha, as in Case 4C, would appear to be unsatisfactory but was not given adequate clinical trial.

## SUMMARY

In a series of fourteen cases of hemophilia A and one case of hemophilia B, the systemic and local approach to tooth extraction is outlined.

The fundamental importance of supplying the deficient coagulation factors by pre- and postoperative transfusion is emphasized. Conservative dental measures are strongly advocated, but in cases of gross neglect natural exfoliation is accepted. The relative value of pressing, packing, suturing, and protecting the socket, with or without a local vasoconstrictor or coagulant, is discussed. The results of protection by removable, semifixed, and fixed splints are presented. The over-all value of splints is indicated by a comparison of our findings with the results of three other workers.

We advise extraction with endotracheal anesthesia and oral antibiotic cover, followed by the use of a fixed silver cap splint lined with gutta-percha in the socket area.

This appliance was found to reduce bleeding in six cases to an average of 1.5 days. In a severe case, however, this hemorrhage may occur at any time during a period of ten days.

An edematous tissue reaction was noted with all types of splint in patients with moderate and severe hemophilia and was most marked between the seventh and tenth days. This factor may indicate a vascular as well as a coagulation defect.

Our thanks are due Dr. M. G. Nelson and Professor P. J. Stoy for assistance in the preparation of this paper; Mr. R. J. Smith, Lecturer in Conservative Dentistry, for assistance in inaugurating a system of dental inspection and treatment; the Prosthetic and Haematological Departments and in particular Mr. A. Allen, Chief Dental Technician, for the construction of the splints; and Mr. G. Smith, medical artist, for the illustrations.

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## PERIODONTICS

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# GINGIVAL CHANGES OBSERVED IN ARTERIOSCLEROTIC MEN

## A Clinical and Histologic Study

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GINGIVAL specimens obtained at autopsy from patients with known arteriosclerotic heart disease have shown alterations in the gingival vascular bed which are similar to arteriosclerotic changes observed in other parts of the body.[1, 2] In the present investigation changes in gingival specimens obtained from patients with known arteriosclerotic heart disease were studied and compared with specimens obtained from patients within similar age groups who did not have arteriosclerotic heart disease.

### MATERIALS

Forty-two male patients at the New York Veterans Administration Hospital, ranging in age from 35 to 66 years of age, were selected for this study. Twenty-one patients of this group had an admission diagnosis of arteriosclerotic heart disease; the remaining patients had various nonchronic diseases. Patients who showed evidence of oral mucous membrane lesions were not included in this study.

### METHODS

Every patient was examined by clinical and radiographic methods for evidence of periodontal disease. Patients with marked periodontal disease were excluded from the study. In the biopsy areas, pocket depth was determined with the use of a Merrit calibrated millimeter probe. The clinical appearance of the area was noted according to the PMR index. Degree of calculus was estimated as slight, moderate, or severe. Each patient was given a complete medical examination, and pertinent information was listed on a clinical examination form devised for this study.

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This study was submitted in partial fulfillment of the senior author's requirements for the degree of Master of Science in Dentistry at New York University College of Dentistry.

Gingival biopsy specimens were removed surgically from the buccal aspects of maxillary and mandibular premolars and molars in areas free from active periodontal disease. The average width of the sections was 0.5 cm. Following removal, specimens were washed under running water and immediately placed in Bouin's fixative.

Ward's surgical pack was applied to the biopsy area. Every patient was recalled for at least three postoperative visits to determine the progress of healing.

The gingival specimens were dehydrated, cleared, embedded in paraffin, and cut at 6 microns. Serial sections were stained with hematoxylin and eosin stain, Masson's trichrome stain, periodic acid-Schiff stain, and Weigert's resorcin-fuchsin elastic stain.*

### GROSS OBSERVATIONS IN PATIENTS WITH ARTERIOSCLEROTIC HEART DISEASE

All patients in this group had an established diagnosis of arteriosclerotic heart disease on hospital record. The average age of the patients was 52 years. Three of the twenty-one patients were Negroes. Retinal blood vessel changes, as determined by the examining physician, were present in fifteen of the twenty-one patients. These changes consisted primarily of arteriolar-venous nicking and arteriolar narrowing. The average blood pressure of the patients was 159/92 mm. Hg, and blood pressures ranged from a high of 205/135 to a low 120/72 mm. Hg.

### ORAL EXAMINATION IN PATIENTS WITH ARTERIOSCLEROTIC HEART DISEASE

Clinical examination of the oral mucosa presented no marked abnormalities. The crevicular depth in the biopsy area ranged from 2 to 4 mm., with an average of 2.8 mm. Slight evidence of gingival inflammation, as determined by the PMR index, was noted in eleven patients. A slight amount of calculus was present in thirteen patients, and there was a moderate amount of calculus in eight patients. All biopsy areas healed uneventfully.

### HISTOLOGIC OBSERVATIONS IN PATIENTS WITH ARTERIOSCLEROTIC HEART DISEASE

Ulceration of the epithelium was seen in four specimens. The remaining specimens showed a normal or slightly widened epithelial layer. An inflammatory infiltrate consisting primarily of lymphocytes and plasma cells was seen beneath the epithelium in all cases.

Sixteen of the twenty-one specimens showed amorphous-appearing areas, with a decrease in nuclear detail within the collagen bundles in hematoxylin and eosin stain. These areas stained more deeply eosinophilic than the surrounding collagen. The periodic acid-Schiff reaction also showed fuchsinophilic response in these areas. The degree of staining intensity varied in the specimens (Figs. 1 to 4). The amorphous sites stained fuchsinophilic with Masson's trichrome

*The staining techniques followed those outlined in U. S. Armed Forces Institute of Pathology: Laboratory Manual of Histologic and Special Staining Techniques, Washington, D. C., 1958, American Registry of Pathology.

stain (Figs. 1 to 5). Four additional specimens showed fuchsinophilic staining areas of collagen with Masson's trichrome stain, although amorphous changes were not demonstrated in the sections stained with hematoxylin and eosin (Figs. 5 to 10).

Fig. 1.

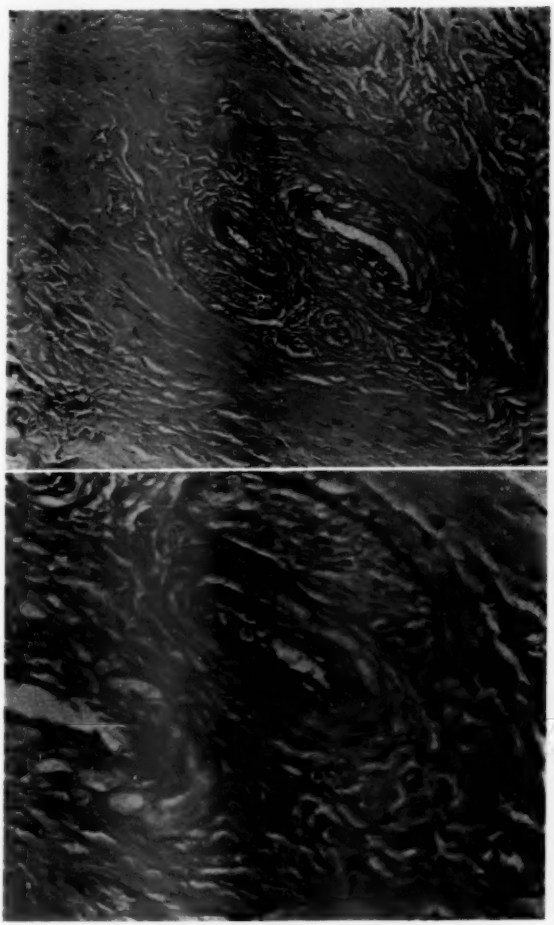

Fig. 2.

Fig. 1.—Photomicrograph of a gingival biopsy specimen from a 52-year-old patient with diagnosed arteriosclerotic heart disease. Note the altered collagen bundles and thickened arteriolar walls. (Hematoxylin and eosin stain. Magnification, ×150; reduced ⅙.)

Fig. 2.—Higher magnification of specimen shown in Fig. 1. Note the degenerative changes in intima of arteriole (arrow) as evidenced by swelling of endothelial cells. (Hematoxylin and eosin stain. Magnification, ×400; reduced ⅙.)

The intensity of fuchsinophilia, as seen with the periodic acid-Schiff reaction, did not parallel the intensity of fuchsinophilia seen in the serial sections stained with the trichrome stain.

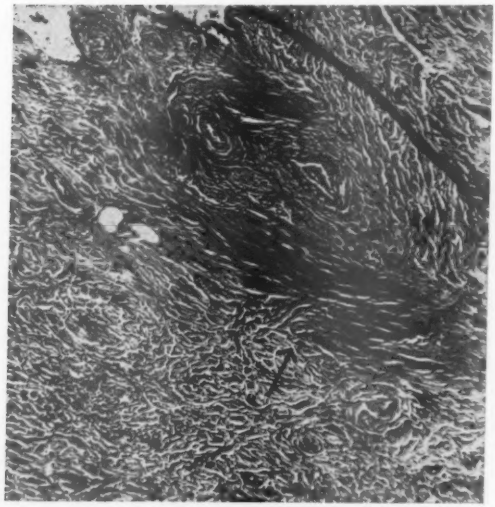

Fig. 3.—Photomicrograph of a serial section from the specimen shown in Fig. 1. Note the fuchsinophilic staining collagen bundles (arrow). (Masson's trichrome stain. Magnification, ×90; reduced ⅙.)

Fig. 4.—Higher magnification of specimen shown in Fig. 3. Note the marked narrowing of lumina due to endothelial hyperplasia, and fuchsinophilia of collagen. (Masson's trichrome stain. Magnification, ×400; reduced ⅙.)

Fourteen specimens showed thickening of the arteriolar vessel walls; this varied from slight to severe thickening, with a concomitant reduction in lumen size. Several of the specimens also demonstrated degenerative changes of the vessel walls. Elastic reduplication of the internal elastic membrane was noted in five specimens (Figs. 6 to 9).

Fig. 5.

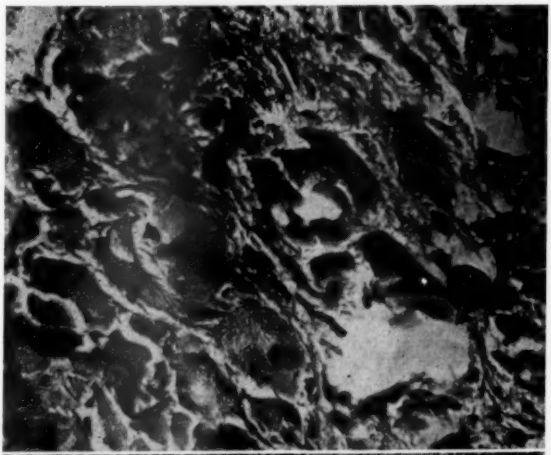

Fig. 6.

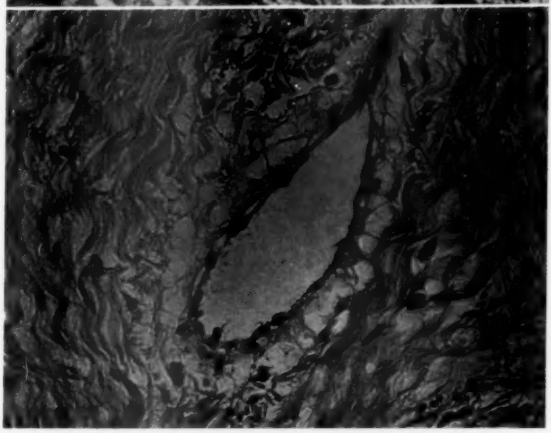

Fig. 5.—Photomicrograph of a section from a gingival biopsy specimen from a 54-year-old patient with arteriosclerotic heart disease. Note the amorphous, deeply staining fuchsinophilic collagen bundles. (Masson's trichrome stain. Magnification, ×400; reduced ⅙.)

Fig. 6.—Photomicrograph of a gingival biopsy specimen from a 56-year-old patient with diagnosed arteriosclerotic heart disease. Note the degenerative changes of the vessel wall (vacuolization beneath endothelium). (Masson's trichrome stain. Magnification, ×400; reduced ⅙.)

## GROSS OBSERVATIONS IN CONTROL GROUP

The average age of these patients was 52 years. Three of the patients were Negroes. Retinal blood vessel changes, as determined by the examining

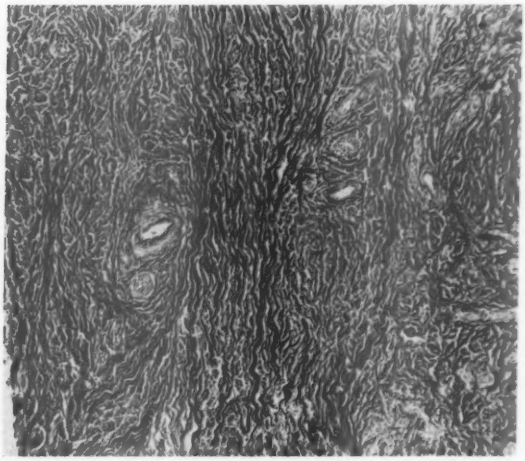

Fig. 7.—Photomicrograph of a serial section from specimen shown in Fig. 3. Note the presence of elastic-staining fibers in the walls of several blood vessels. (Weigert's elastic stain. Magnification, ×50; reduced ⅙.)

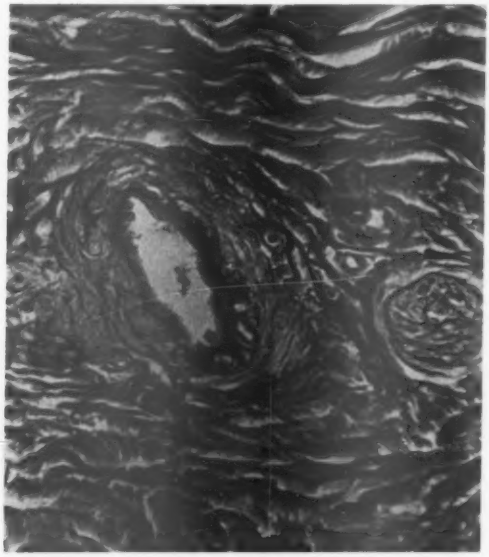

Fig. 8.—Higher magnification of specimen shown in Fig. 7. Note the evidence of splitting, reduplication, and fragmentation of internal elastic membrane. (Weigert's elastic stain. Magnification, ×400; reduced ⅙.)

physician, were not present in any of the patients. The average blood pressure was 132/81 mm. Hg, with a range from a high of 160/90 to a low of 110/60 mm. Hg.

### ORAL EXAMINATION IN CONTROL GROUP

Clinical examination of the oral mucosa disclosed no marked abnormalities. The crevicular depth in the biopsy areas ranged from 2 to 4 mm., with an average of 2.9 mm. Slight evidence of gingival inflammation, as determined by the PMR index, was noted in thirteen patients. A slight amount of calculus was present in eleven patients, and there was a moderate amount in ten patients. All biopsy areas healed uneventfully.

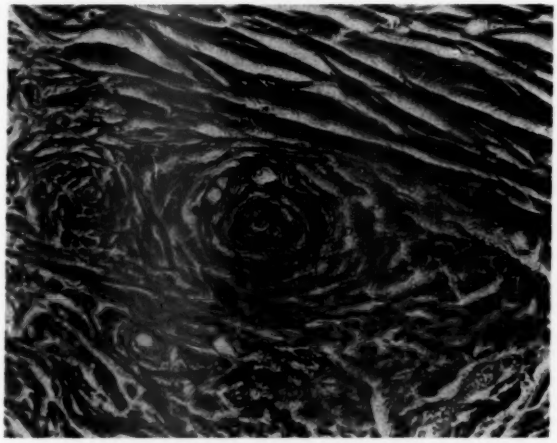

Fig. 9.—Higher magnification of specimen shown in Fig. 7. Note the appearance of another arteriole with splitting, reduplication, and thickening in internal elastic membrane. Also note the practically obliterated lumen. (Weigert's elastic stain. Magnification, ×400; reduced ⅙.)

### HISTOLOGIC OBSERVATIONS IN CONTROL GROUP

The epithelium appeared parakeratotic in all specimens studied. A widening of the epithelial layer (acanthosis) was noted in eight specimens. This was usually observed in association with a subepithelial round-cell inflammatory infiltrate. Ulceration was present in four cases.

Six of the twenty-one specimens showed amorphous-appearing areas with a decrease in nuclear detail among the collagen bundles in the hematoxylin and eosin stain. These areas stained more deeply eosinophilic than the surrounding collagen.

The periodic acid-Schiff reaction did not always stain the above areas fuchsinophilic. The degree of staining intensity varied in the specimens, but it was much less than was observed in the arteriosclerotic patients. With Masson's trichrome stain, four of the six areas mentioned above showed a fuchsinophilia of the collagen bundles.

Four specimens demonstrated slight thickening of the arteriolar vessel walls with some reduction in the diameter of the lumen. One of the specimens showed evidence of degenerative changes in the vessel wall. Elastic reduplication was not noted in any of the control specimens (Figs. 10 and 11).

Fig. 10.

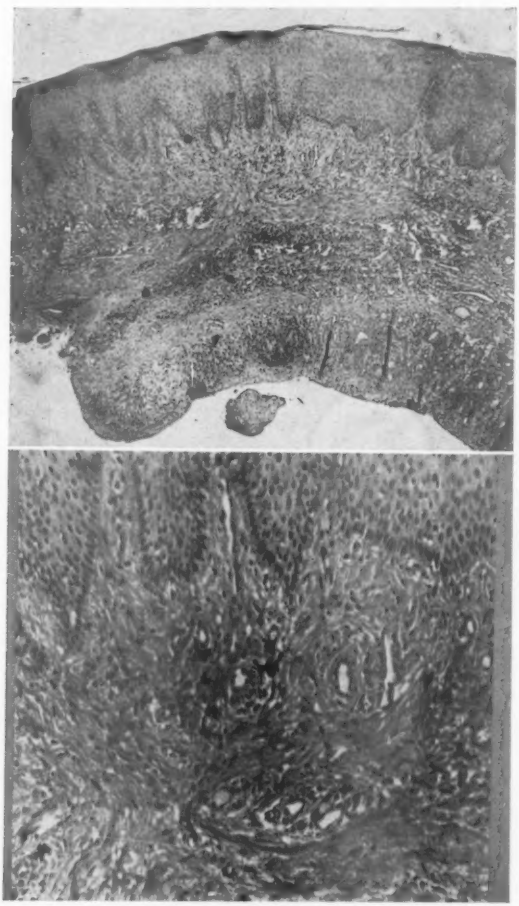

Fig. 11.

Fig. 10.—Photomicrograph of a gingival biopsy specimen from a 53-year-old patient with admission diagnosis of depressive reaction. Note the presence of slight round-cell infiltrate. (Hematoxylin and eosin stain. Magnification, ×50; reduced ⅙.)

Fig. 11.—Higher magnification of specimen shown in Fig. 10. Note the distribution of arterioles and the size of the lumina. (Hematoxylin and eosin stain. Magnification, ×150; reduced ⅙.)

## DISCUSSION

In a comparison of gingival biopsies from control patients and arteriosclerotic patients, the most striking changes were the tinctorial differences noted

in the collagen bundles and the blood-vessel changes. With hematoxylin and eosin stain, there were demonstrated many more amorphous-appearing, deeply eosinophilic-staining areas in the collagen bundles in specimens from patients with arteriosclerotic heart disease than in specimens from the control group. Masson's trichrome and the periodic acid-Schiff stain also showed a fuchsinophilia in these areas in many specimens. Degenerative changes of the arteriolar wall were seen primarily in the arteriosclerotic patients. With elastic stain, evidence of elastic reduplication was noted only in the arteriosclerotic patients.

The literature describes the presence of hyaline degeneration in the collagen of patients with arteriosclerotic heart disease. Boyd[3] states:

> Hyaline degeneration denoted a physical rather than a clinical change and the tissue becomes translucent or hyaline and stains lightly red with acid dyes such as fuchsin which is in Masson's trichrome stain. Hyaline degeneration affects chiefly collagenous connective tissue and fibrous tissue in the walls of blood vessels. It is seen in chronic malnutrition and in old age, but the exact factors responsible are not certain. The change is well seen in arteriosclerosis. In the intima, the tissue undergoes a hyaline change. The subendothelial layer of the arterioles shows marked hyaline thickening. Scar tissue undergoes a similar change. In all of the above instances, the fibrous tissue loses its structure and the fibers become homogenous and stain red with acid stains.

It is to be noted that homogeneous-appearing areas of collagen which stain strongly eosinophilic with hematoxylin and eosin stain and fuchsinophilic with the periodic acid-Schiff reaction have also been described as undergoing fibrinoid degeneration.[4, 5] Gillman[6] has described altered collagen fibers occurring after mechanical, radiation, and possibly metabolic trauma, which stain with the fuchsin of the trichrome stain. On the basis of the foregoing, it is suggested that the collagen which stained fuchsinophilic with the periodic acid-Schiff reaction and Masson's trichrome stain demonstrated degenerative changes. No general agreement, however, exists on the exact nature of these alterations.

Comment should be made regarding the possibility that the changes observed in the collagen of the gingival specimens may be the result of local gingival inflammation. Since the altered collagen, however, was observed to a much greater degree in specimens from patients with arteriosclerotic heart disease than in the control specimens, even though inflammation was present in both groups, it is highly suggestive that the collagen alterations described may be associated with generalized rather than local factors.[7-10] Changes observed in study of elastic components in arterioles of the gingiva were similar to those described for other vessels altered by arteriosclerosis. These observations confirm previous findings which demonstrate that arteriolar changes in gingival vessels are associated with arteriosclerosis.[1, 2]

## SUMMARY AND CONCLUSIONS

Forty-two male patients, varying in age from 35 to 66 years and hospitalized at New York Veterans Administration Hospital, received complete medical and dental examinations and submitted to gingival biopsies. Arteriosclerotic heart disease had been diagnosed in twenty-one of these patients. The remaining patients were hospitalized with various nondebilitating diseases.

1. The gingival mucosa showed no clinical difference between the two groups.

2. Histologic changes, however, were noted in the patients with arteriosclerotic heart disease and were present to a much lesser degree in the control patients. The histologic changes consisted essentially of (a) an alteration of the collagen characterized by the presence of amorphous areas within the collagen bundles which stained fuchsinophilic with Masson's trichrome stain and periodic acid-Schiff stain and (b) a thickening of arteriolar vessel walls with a concomitant reduction in lumen size. Elastic reduplication of the internal elastic membrane of the arterioles was also observed in several specimens from the arteriosclerotic heart disease group.

The authors wish to thank Dr. I. Scopp, Chief, Dental Service, Veterans Administration Hospital, New York, New York, for his help in obtaining this material.

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# ORAL MEDICINE

## RECURRENT APHTHOUS ULCERATIONS AND RECURRENT HERPES LABIALIS IN A PROFESSIONAL SCHOOL STUDENT POPULATION

### I. Experience

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*Bethesda, Md., and Philadelphia, Pa.*

#### INTRODUCTION

RECURRENT painful ulcerations on the oral mucous membranes have been described under twelve synonyms in the literature of the past few decades.[1] Most commonly referred to as "canker sores," aphthous ulcerations are characterized by recurrences of round to oval, crateriform lesions in the labial, buccal, lingual and sublingual, gingival, and palatal mucosa. These painful ulcers, which measure from 2 to 20 mm. in diameter, persist for one to three weeks, depending on size, location, and the patient's individual characteristics. Although a vesicular stage has been frequently seen,[2] other observers have described the initial formation of a small area of redness on the mucosa. This is rapidly followed by central necrosis and subsequent slough.[3-5] A grayish white, fibrinous base is surrounded by a bright red areola. The margins are regular and are not undermined. On the basis of questionnaire data from 1,587 consecutive patients attending outpatient clinics in two English hospitals, Sireus and associates[1] have reported the over-all prevalence of this condition to be 20.1 per cent. The disease was found to be more common in female patients. On the basis of 120 cases, the greatest number of initial lesions occurred in the second decade of life, and in more than 50 per cent of the patients onset of the disease occurred between the ages of 10 and 30. Nearly 40 per cent of the female patients suffered crops of ulcers at intervals of less than eight weeks,

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while most male subjects (45 per cent) experienced three or four new crops per year. A rhythmic periodicity of attacks was noted in most subjects.

Recurrent herpes labialis, better known as "fever blister" or "cold sore," is characterized by the recurrent appearances of a vesicular eruption on or adjacent to the vermilion border of the lips. On the basis of antibody titer studies in small population groups, it has been estimated that 50 to 75 per cent of the population is susceptible to recurrences.[6-9] Herpes simplex virus has been cultured from vesicular fluid, and all patients with the condition demonstrate high levels of specific antibody titer to herpes simplex virus.[7, 10]

Black,[11] in 1942, demonstrated the relationship of herpes simplex to recurrent "fever blisters" by inoculating the gingiva of a child with material from a typical "cold sore." He observed the ensuing illness recognized as primary acute herpetic gingivostomatitis. Isolation of the virus and demonstration of rising antibody titers with convalescence were reported.

A viral etiology of recurrent aphthous ulcerations has been suggested by many authors, and herpes simplex virus has been mentioned most frequently.[6, 12-14] Because of the similarity of factors that can initiate recurrences of "fever blisters" and "canker sores," and because of the proximity of the two lesions, there has been considerable controversy on this point. Whereas sufficient evidence has accumulated to indicate that recurrent fever blisters are caused by this virus, there has been no positive indication that aphthous ulcerations are caused by the same agent.[15-17] Indeed, it appears that herpes simplex virus cannot be the cause of recurrent aphthous ulcerations.

Stark and associates[3] compared antibody titers to herpes simplex virus in a large group of patients with recurrent aphthous ulcerations and in a group from the general population. They found that 55 per cent of aphthous stomatitis patients had high titers and that 85 per cent of the control population had high titers. Blank and colleagues[10] compared the ratio of persons suffering from recurrent aphthous ulcerations who had high antibody titers with patients recovering from primary herpetic gingivostomatitis and patients with recurrent fever blisters. They showed that a smaller proportion of patients with canker sores had high levels of antibodies than did those in the other two groups, in whom high titers were always present. Swabs, scrapings, and biopsy material taken from aphthous lesions have been cultured in a variety of tissue cultures and living hosts. Attempts to grow herpes simplex or other viruses from recurrent aphthous ulcerations in all stages of formation and resolution have been uniformly unsuccessful.[4, 7, 10, 18, 19]

In view of continuing controversy on the subject, it was felt that examinations in a population with respect to recurrent aphthous ulcerations and to the recurrent vesicular eruptions on the lips known as "fever blisters" or "cold sores" would shed new light on both conditions.

The purpose of this study was to determine the prevalence of and patients' experience with recurrent aphthous ulcerations and recurrent herpes labialis in a student population and to examine possible interrelationships between the two conditions.

## MATERIALS AND METHODS

This study was conducted on the student bodies of the Schools of Medicine, Dentistry, Dental Hygiene, Veterinary Medicine, Graduate Nursing, and Hospital Nursing of the University of Pennsylvania. In addition, students at the schools of nursing of the Philadelphia General Hospital and the Presbyterian Hospital were included.

The investigations were divided into four phases: (1) administration of questionnaires to the entire population; (2) determination of medical histories of the entire population; (3) oral examinations on persons with severe recurrent aphthous ulcerations; and (4) maintenance of diary forms documenting location and duration of all oral ulcerations for extended periods in persons susceptible to frequent recurrences of "canker sores."

Only the first of these studies will be described in this article.

It is felt that this group represented a stable population of both sexes in the age range reported to have the highest incidence of onset[1] and one in which the academic orientation in the healing arts would ensure good cooperation and continued interest in the study.

**RESEARCH PROJECT NO. 58-001**

**(This information is confidential and will not be released to unauthorized persons)**

**PLEASE LEAVE ANY SPACES BLANK THAT YOU DO NOT WISH TO ANSWER**

Full Name _____ Unit Number _____
Last First Middle (Do not fill in)

Home Address _____
Number, street or RFD, city or town, zone, and State

Home Tel. No. _____ School Tel. No. _____ Sex: M F

School Address _____
Number, street or RFD, city or town, zone, and State

Date of Birth _____ Place of Birth _____ Nationality _____
Mo. day yr. City State

Marital Status: S M D W Sep. School: Med. Dent. Nurs. Hyg. Race _____

Class I II III IV Religion _____ Date _____

PHS-2884-1 (10-58) QUESTIONNAIRE—RECURRENT APHTHOUS ULCERATIONS

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

BUDGET BUREAU NO. 68-R003
APPROVAL EXPIRES: 12-31-60

Fig. 1.

Because of the different degrees of interest and emphasis on oral disease in the various schools and classes represented in this population, it was felt that broad variation in interpretation of the questions was possible. Therefore, an orientation lecture describing and differentiating between the various conditions under study was given to each group of students prior to distribution of the questionnaires. Students were advised to answer in the negative if uncertain as to their own history of disease. Thus, all data represent analysis of individual and group responses following orientation and description of the conditions under study.

A questionnaire designed to determine the individual student's experience with recurrent aphthous ulcerations, recurrent herpes labialis, and Vincent's infection was employed. Frequency of recurrences, family history, and other

information were requested as well (Figs. 1 and 2). Responses were carefully checked for accuracy by comparison with answers to similar questions on a medical history form subsequently distributed.

For purposes of analysis, with respect to both recurrent aphthous ulcerations and recurrent herpes labialis, only subjects responding in the affirmative who indicated a frequency of more than one recurrence were included in the positive groups for either disease. Therefore, a single episode of either condition was insufficient for a definitive diagnosis of a recurrent disease. All doubtful responses were included in the negative groups.

**RESEARCH PROJECT NO. 58-001: Recurrent Aphthous Ulcerations**

**(This information is confidential and will not be released to unauthorized persons)**

1. Have you ever had 'cold sores' or 'fever blisters' on your lips? ☐Yes ☐No
2. How frequently have these occured? daily weekly monthly 2-3/yr every few yrs once (____yrs)
3. How old were you when your first 'cold sore' appeared? _____ Yrs (approx.)
4. Does anyone in your family suffer from 'cold sores'? ☐No ☐Yes (Who? _____)
5. Have you ever had 'canker sores' or other ulcers, blisters, or sores in the mouth?
   ☐Yes ☐No ☐Don't know
6. How frequently do these sores occur?
   ☐Daily ☐weekly ☐monthly ☐2-3/year ☐every few yrs ☐only once (_____ yrs)
7. Does anyone in your family suffer from ulcers, blisters, or 'canker sores' in the mouth?
   ☐No ☐Yes Who?_____
8. Have you ever had 'Trench Mouth' or 'Vincent's Infection'? ☐No ☐Yes
   If so, when? _____

PHS-2964-1 (BACK) (10-58)

Fig. 2.

## RESULTS

A total of 1,039 male subjects (mean age, 23.7 years) and 749 female subjects (mean age, 19.1 years) were studied. On the basis of total registered students during the week in which questionnaires were administered, 85 per cent of the total available student population participated. Of the eight schools we obtained 90 per cent participation in six, 80 per cent in one, and 53 per cent in one. The poorer responses in the latter two schools were caused by the absence of significant numbers of students due to clinical assignments in locations remote from the examining facility.

*Recurrent Aphthous Ulcerations.*—It was found that 57.3 per cent of all female students questioned had a history of recurrent aphthous ulcerations, while 52.4 per cent of all male subjects had had this condition in the past (Fig. 3). These percentages tend to be significantly different ($0.05 < p > 0.02$). This is not the result of age, as the male subjects were older and would have had a longer period of exposure during which to develop lesions. Furthermore, the age distributions of aphthous ulcerations in positive male subjects and positive female subjects were similar. Mean ages of the positive and negative male students were the same (23.6 and 23.7), as were those of the female students (19.0 and 18.5).

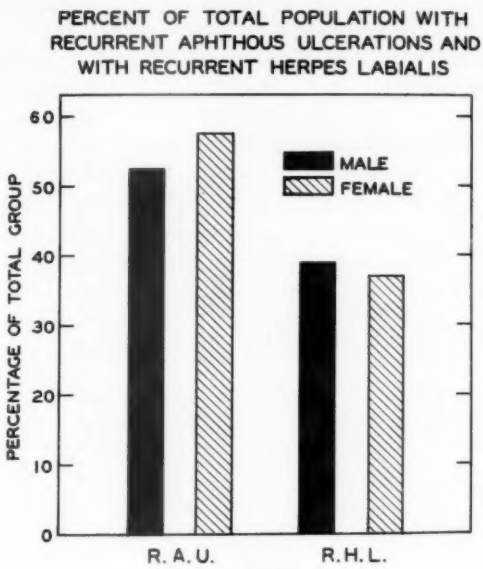
PERCENT OF TOTAL POPULATION WITH
RECURRENT APHTHOUS ULCERATIONS AND
WITH RECURRENT HERPES LABIALIS
PERCENTAGE OF TOTAL GROUP
60
50
40
30
20
10
0
MALE
FEMALE
R. A. U.
R. H. L.

Fig. 3.

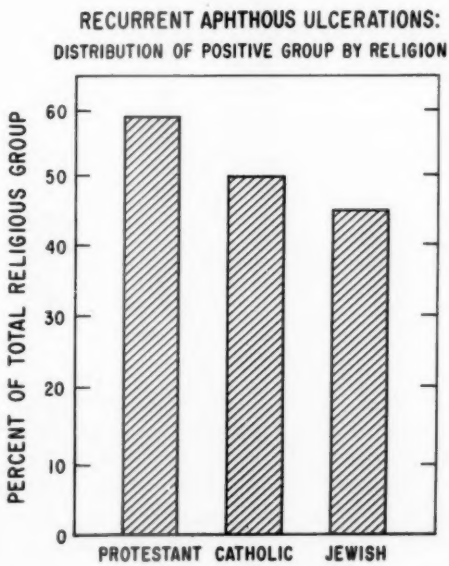
RECURRENT APHTHOUS ULCERATIONS:
DISTRIBUTION OF POSITIVE GROUP BY RELIGION
PERCENT OF TOTAL RELIGIOUS GROUP
60
50
40
30
20
10
0
PROTESTANT
CATHOLIC
JEWISH

Fig. 4.

Analysis of the positive groups for race, school, geographic origin, and marital status revealed no significant differences.

Significant differences between students of different religious classifications were noted, however (Fig. 4). Protestants differed significantly from both Catholics and Jews ($p = 0.01$), but no differences were noted between the latter two groups. These religious group differences were seen in all group analyses.

Analysis of responses regarding family history of recurrent aphthous ulcerations appeared to indicate positive relationships until answers were compared with responses to identical questions subsequently collected from 85 per cent of the group on medical history forms. These revealed that both the positive and the negative groups had little information regarding the presence or absence of the diseases under question in parents or siblings.

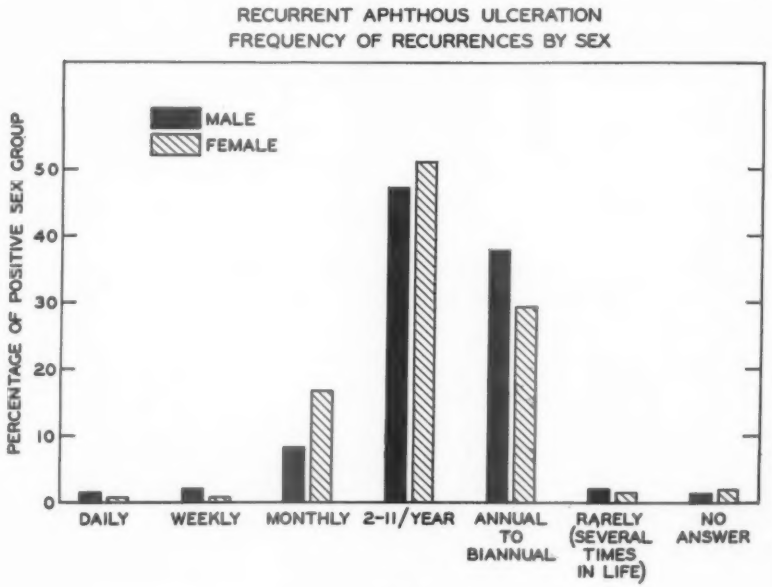


Fig. 5.

Recurrent "canker sores" is a disease of exacerbations and remissions. Analysis of data on the periodicity of ulcerations indicated no differences between male and female patients. Fourteen per cent of the students with a history of aphthous ulcerations reported recurrences of lesions at intervals of one month or less, 50 per cent had recurrences at intervals of from two months to eleven months, and 36 per cent reported annual or less frequent recurrences (Fig. 5). The "no answer" group indicated irregular and isolated episodes of single ulcer formation. This group also includes students who reported having had the disease in childhood but who had experienced no recurrences for many years.

*Recurrent Herpes Labialis.*—Of the 1,788 students, 38.2 per cent reported a positive history of recurrent herpes labialis or "fever blisters." There were small differences between the sexes, as seen in Fig. 3. Age, school, geographic origin, marital status, and racial background revealed no significant differences.

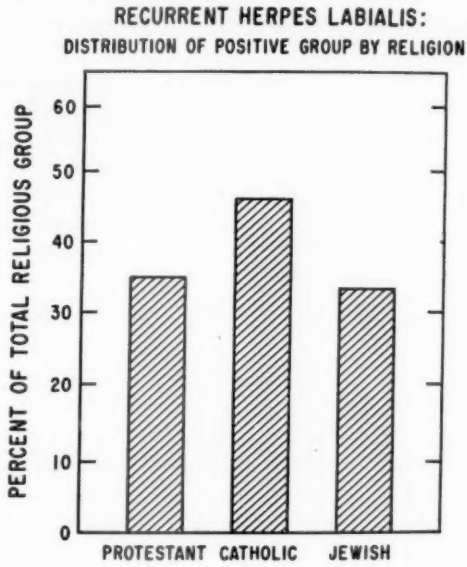


Fig. 6.

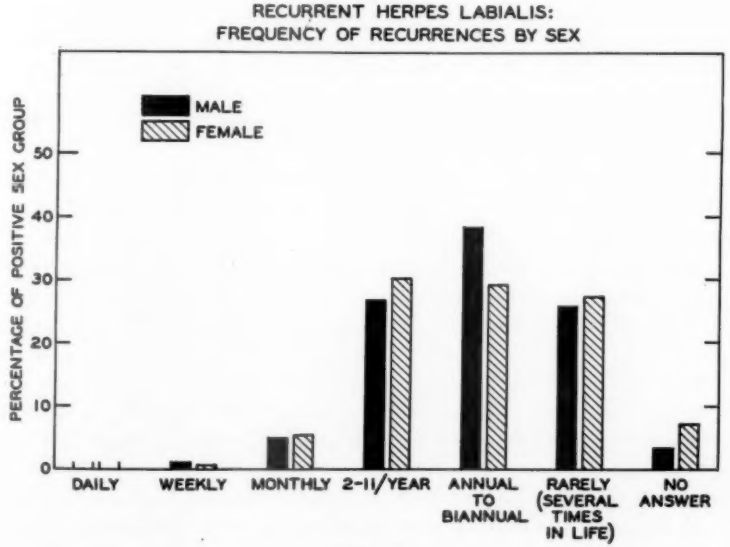


Fig. 7.

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Significant differences were noted between students of different religious classifications, however (Fig. 6). The figures for Catholics were significantly higher than for either Protestants or Jews, and the latter two groups showed similar percentages.

Once again, responses to questions concerning family history were paradoxical, as careful checking with medical history responses to similar questions indicated different answers.

Analysis for the frequency of recurrences revealed no significant sex differences. In the positive group, 5.4 per cent reported one or more lesion recurring each month, 34 per cent had recurrences at intervals of from two to eleven months, and 61 per cent reported recurrences at intervals of one year or more. Five per cent of the students in this group (listed as "no answer") indicated isolated and irregular episodes of single vesicle formation. This group also includes students who reported frequent episodes of fever blisters in childhood but no subsequent recurrences (Fig. 7).

## DISCUSSION

The results of this study indicate that recurrent aphthous ulcerations are more frequent than has been previously noted. Sircus and co-workers[1] reported the over-all prevalence to be 16.9 per cent in males and 23.3 per cent in females. For the second decade they found the experience to be 26 per cent in males and 24 per cent in females, while in the third decade it was 30 per cent in males and 37 per cent in females. Whether the larger figures reported in this study reflect selection factors due to the limited populations studied is not known at this time. A finding of 52 per cent in males and 57 per cent in females in any population would indicate that further studies should be performed. That females differ from males with respect to recurrent aphthous ulcerations has long been suggested. The reasons for this difference, however, are obscure at this time. It is interesting to note that females did not differ significantly from males in frequency of recurrences. One would suspect that if recurrences were related to the menses a significantly larger group of female patients would report monthly episodes of canker sores.

Sex differences were not seen in the groups with recurrent herpes labialis, and the actual prevalence of this condition in the population studied was less than had been suspected.

Comparisons of both diseases in the same population provided for several interesting observations. Strong religious group differences, which appeared in all analyses, were demonstrated for both diseases. However, the religious groups favored by recurrent aphthous ulcerations were not the same as those favored by recurrent herpes labialis. Significant representation of each group was present in all schools, and the differences reported could not be explained on the basis of age, sex, or other factors. The reasons for these differences are obscure at this time.

Comparison of both diseases with regard to frequency of recurrence indicates that students with canker sores experienced these ulcerations at shorter intervals of time than those with recurrent fever blisters (Fig. 8). It would

thus appear that in this population recurrent canker sores are a greater problem as regards both the percentage of students who are susceptible and the frequency in which active disease is manifested.

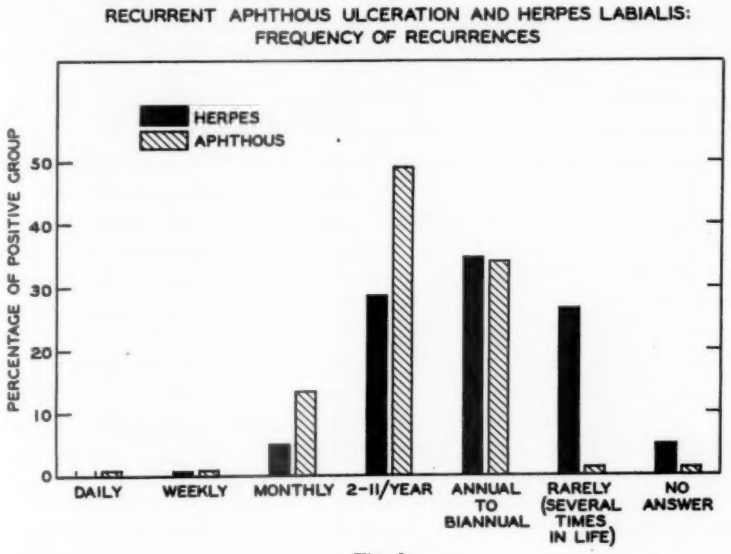


Fig. 8.

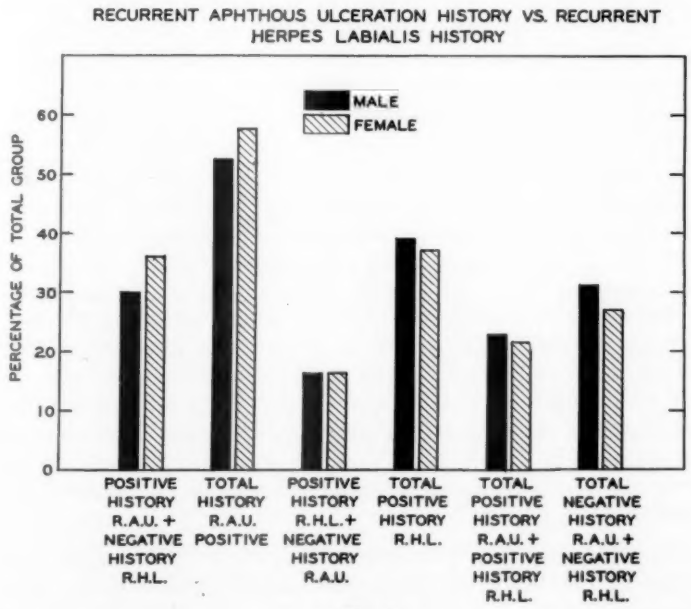


Fig. 9.

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Examination of the interactions between both conditions in the same population is possible by determining mathematically the number of students with recurrent aphthous ulcerations that should also have fever blisters on the basis of the percentages seen (males, 52; females, 57 per cent) with each condition. Subsequent comparison with the actual numbers of subjects who have canker sores and who also have fever blisters would tend to suggest whether interactions between the two conditions do or do not exist for each sex. In a similar fashion, the actual and expected numbers of students who have fever blisters and who also have canker sores can be compared (Fig. 9).

The number of female students with both diseases is what would be expected on the basis of prevalence of those who have either condition if the etiology were similar. This situation does not exist in male students, as the number with both diseases is exactly what would be expected on the basis of prevalence of either condition if the etiologies were different. Therefore, the sexes differ with respect to the interrelationships between recurrent aphthous ulcerations and recurrent herpes labialis in the same population. Whether this difference is due to etiological or physiologic factors is not known at this time. Certainly, further investigations into these sex differences are indicated.

It is interesting to note that paradoxical responses to questions of family history of both conditions were noted when the questionnaire was compared with responses on a medical history form completed and checked at a later date. Careful checking of the conflicting answers indicated that students did not necessarily know of the presence of the disease in parents and siblings. It appeared that knowledge of recurrent aphthous ulcerations or recurrent herpes labialis within the immediate family was strictly dependent on the presence or absence of disease in the respondent. This suggests that information concerning minor diseases pertaining to persons other than the respondent should be carefully checked in any study of this nature.

## SUMMARY AND CONCLUSIONS

Recurrent aphthous ulcerations or "canker sores" constitute a common but poorly understood condition of the oral mucous membranes characterized by recurrent appearances of painful ulcerations on the mucosal surfaces of the inner lips, cheeks, tongue, gingivae, and other intraoral sites. In susceptible patients, recurrences may be frequent and regular or infrequent and irregular. There is evidence that these ulcerations are not caused by the herpes simplex virus. Recurrent herpes labialis or "fever blisters" is characterized by the recurrent appearances of painful blisters on the vermilion border of the lip. The virus of herpes simplex has been demonstrated to be the causative agent. Eighty-five per cent of the total available students attending eight professional schools were included in this study. Following demonstrations of both conditions, a questionnaire was administered to 1,800 students. Analysis of results indicated the following:

1. In this group, 52.4 per cent of the male students and 57.2 per cent of the female students had a history of recurrent aphthous ulcerations. The sex difference was significant.

2. Thirty-eight per cent of the students in this population had a history of recurrent herpes labialis. No sex difference was noted.

3. Age, racial background, marital status, school, and class differences were not seen in either disease.

4. Significant but different religious group differences were observed for both conditions.

5. Students susceptible to episodes of canker sores experienced more frequent recurrences than students susceptible to fever blisters.

6. Knowledge of these diseases in members of the immediate family was unreliable and proved to be paradoxical when checked.

7. In females, the etiology of the two conditions appears to be similar on the basis of expected and observed proportions of the population who have both diseases. In males, however, the etiology appears to differ, as both conditions occur independently of each other in this population.

The authors are grateful to Mr. Carl White, Epidemiology and Biometry Branch, National Institute of Dental Research, United States Public Health Service, Department of Health, Education, and Welfare, for his help in statistical analysis, and to Mrs. Olivia Richardson, without whose conscientious work this study would not have been successful.

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## SURGICAL ANATOMY AND PHYSIOLOGY

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# THE STRUCTURE OF THE TEMPOROMANDIBULAR JOINT

*Nicholas C. Choukas, D.D.S., M.S., and*
*Harry Sicher, M.D., D.Sc., Chicago, Ill.*

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### INTRODUCTION

ALTHOUGH much has been written on the anatomy and function of the temporomandibular joint, there have evolved many clinical concepts that are based on inadequate knowledge of the normal anatomy of this joint. Lack of uniformity of good results in the treatment of pain and dysfunction of the temporomandibular joint may be due in part to an incomplete understanding of this joint's normal anatomy. Perusal of the literature reveals an abundance of reports on investigations of various aspects of the temporomandibular joint. Although there is general agreement on much of the anatomy of the temporomandibular joint, some functionally important details have been neglected, namely, (1) the shape of the disc and (2) attachment of the capsule.

The controversial points in the anatomy of the temporomandibular joint are (1) the relation of disc to capsule, (2) the relation of disc to condyle, and (3) the relation of lateral pterygoid muscle to disc and capsule.

In this study an attempt will be made to add some hitherto unknown or neglected details of the structure of this complex joint and to clarify the controversial points.

### FINDINGS

The temporomandibular joint is formed by the articular eminences and articular fossae of the temporal bones superiorly and the heads of the mandible with the articular discs interposed. It is, therefore, an articulation between the mandible and the cranium. With the exception of the joints between the

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This paper is, in part, a condensation of a thesis entitled "The Anatomy of the Temporomandibular Joint in Humans," submitted by Nicholas Choukas in partial fulfillment of the requirements for the degree of Master of Science in Oral Anatomy.

auditory ossicles, the temporomandibular joint is the only true joint among the bones of the head. The fact that an articulating disc is found between the joint's two surfaces makes it a complex type of joint with an upper and a lower compartment. Sagittal sections through the joint show that the upper articular chamber is larger than the lower chamber (Fig. 1).

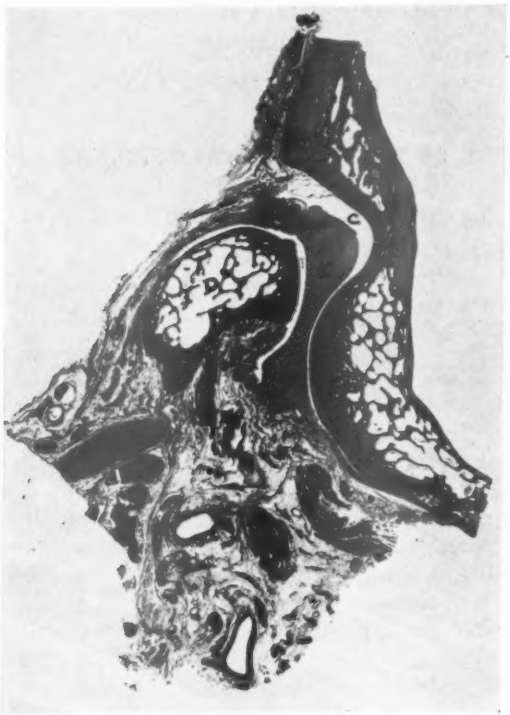

Fig. 1.—Photomicrograph of a sagittal section through the temporomandibular joint. *A*, Fibrous connective tissue covering the articular eminence. *B*, Fibrous connective tissue covering the mandibular condyle. *C*, Upper articular chamber. *D*, Mandibular condyle. *E*, Articular disc. *F*, Articular eminence. *G*, Retrodiscal pad.

The temporomandibular joint is a specialized joint and is different from most other articulations in that the articulating surfaces are not covered by hyaline cartilage but by a fibrous connective tissue which may contain a number of cartilage cells, or chondrocytes.

Actually, the mandibular fossa of the temporal bone does not receive the articulating head of the condyle but only the posterior parts of the interarticular disc.

The posterior slope and the summit of the articular eminence form the anterior wall of the mandibular fossa. The saddle-shaped eminence is convex in a sagittal plane and slightly concave in a transverse plane. The medial and lateral borders of the articular eminence are at times accentuated by

slight bony ridges. Anteriorly, the eminence continues into the infratemporal surface of the temporal bone. There is no anterior slope to the eminentia articularis, but it is often demarcated by a shallow sulcus.

The fibrous connective tissue covering the articular eminence may contain scattered cartilage cells in its deeper layers, and then it may be referred to as "fibrocartilage." The covering of the articulating surface of the temporal bone is thin in the articular fossa and much thicker on the posterior slope and the summit of the articular eminence (Fig. 1). In this area the fibrous connective tissue or fibrocartilage is arranged in two layers. In the outer layer the fibrous bundles appear to be arranged parallel to the surface of the bone. Connective-tissue fibers of the inner layer appear to be perpendicular to the bony surface. In some specimens a definite line of calcification can be noted in the layer adjacent to the bone.

The posterior wall or border of the articular fossa is formed by the postglenoid or preauricular tubercle of the squama of the temporal bone. In profile the tubercle is cone-shaped between the mandibular fossa and the tympanic bone. It may be considered a protective arrangement for the external acoustic meatus in backward displacement of the condyle.

A fissure separates the articular fossa from the tympanic bone. The lateral part of this fissure is the squamotympanic fissure. More medially, a small plate of bone intervenes between the tympanic bone and the squama. This bony plate is the inferior process of the tegmen tympani, which is a part of the anterosuperior surface of the petrous pyramid of the temporal bone. Therefore, the medial part of the squamotympanic fissure is divided into an anterior part called the petrosquamous fissure and a posterior part known as the petrotympanic (glaserian) fissure.

The inner wall of the mandibular fossa is formed by a portion of the squamous temporal bone, which is connected with the angular spine of the sphenoid bone. The roof of the fossa is formed by a thin, translucent part of the squamous temporal bone. The thin, fibrous covering of the fossa and the weakness of its bony roof are proof that the fossa is not a functional part of the temporomandibular joint.

The articulating surface of the mandible is formed by the mandibular condyle or capitulum of the mandible. The condyle measures approximately 2 cm. transversely and 0.5 cm. anteroposteriorly. The long axis of the condyle runs in the same direction as that of the articular eminence and at right angles to the plane of the ramus of the mandible. The extended long axes of the condyles cross each other in the anterior part of the foramen magnum. They thus form an obtuse angle of about 150 to 160 degrees. The condyle is strongly convex anteroposteriorly and slightly convex mediolaterally. The articular surface of the condyle points upward and anteriorly. In a lateral view of the condyle, it seems to bend forward from the neck of the mandible. The condyle rests against the posterior slope of the articular eminence, and movement occurs between the condyle with the disc and the surface of the eminence. The articular surface of the condyle is covered with dense fibrous or fibrocartilagenous tissue of fairly even thickness. Its superficial layers consist of a

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network of strong collagenous fibers. Basophilic cartilage cells may be present and have a tendency to increase with age. These cartilage cells can be recognized by their capsules, which stain blue with a basic dye. Between the fibrous or fibrocartilagenous covering of the condyle and the bone lie the thin remnants of the growth cartilage of the mandible.

There are many variations in the size and shape of the bony condyle. Many of these variations are obscured by the thick covering of the fibrous connective tissue.

The interarticular disc is located between the condyle and the articular eminence. The disc is composed of strong and interwoven bundles of fibrous connective tissue with scattered basophilic cartilage cells.

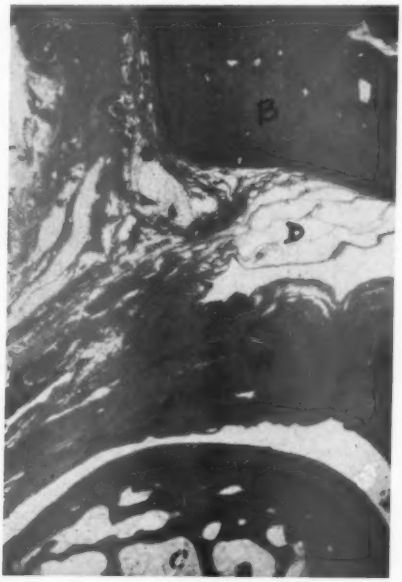


Fig. 2.—High-power view of section shown in Fig. 1. *A*, Retrodiscal pad. *B*, Postglenoid process. *C*, Mandibular condyle. *D*, Broad area of attachment of the capsule on the anterior surface of the postglenoid process.

The central part of the disc is considerably thinner than the periphery. It is about 1 to 2 mm. thick in the center and approximately 3 mm. thick in its posterior border. The posterior border was found to be continuous with a thick layer of loose connective tissue that provides the attachment of the disc to the posterior part of the articular capsule (Fig. 2). This retrodiscal pad is covered on its upper and lower surfaces with a synovial membrane that shows many folds when the condyle rests against the posterior slope of the eminence. When, in anterior movements of the condyle, the retrodiscal pad stretches, the folds of the synovial membrane disappear. Laterally and medially, the disc is attached independently to the lateral and medial poles of the condyle (Figs. 3 and 4). The upper surface of the disc is saddle shaped,

concave anteroposteriorly, and slightly convex mediolaterally. The lower surface of the disc is concave in both directions for adaptation to the ovoid shape of the condyle.

The capsule, which encases the temporomandibular joint, is rather loose and has a funnel-shaped configuration. On the temporal bone it is inserted at the anterior border of the articulating eminence, and laterally it closely follows the corresponding articular margins. Posteriorly, it is not inserted to the edge of the postglenoid lip but in a broad area to the anterior surface of the postglenoid process (Fig. 2). Medially, the capsular attachment extends to the base of the angular spine of the sphenoid bone.

Fig. 3.

Fig. 4.

Fig. 3.—Photomicrograph showing an independent area of origin of the disc and capsule. *A*, Capsule. *B*, Disc. *C*, Condyle.

Fig. 4.—High-power view of section shown in Fig. 3. *A*, Capsule. *B*, Disc. *C*, Condyle.

In the mandible the lateral and medial parts of the capsule attach to the lateral and medial aspects of the mandibular neck below the point of attachment of the disc. Anteriorly, the capsule attaches to the rather sharp ridge that bounds the articular surface of the mandibular condyle anteriorly. Posteriorly, the attachment of the capsule on the mandibular neck is at a lower level than on the anterior surface. There is no fusion of the disc and capsule at the medial and lateral aspects but, rather, independent areas of attachment of disc and capsule.

The lateral surface of the capsule is reinforced to form the strong temporomandibular ligament, the only true ligament of the temporomandibular joint.

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The temporomandibular ligament is triangular in shape, with its most anterior fibers in an oblique direction and its most posterior fibers in an almost vertical position. The latter converge with the oblique anterior fibers to attach just below the attachment of the disc to the lateral surface of the mandibular neck (Fig. 5).

The synovial membrane lines the inner surface of the capsule and the upper and lower surfaces of the retrodiscal pad. Posteriorly, it follows the fibrous capsule to its attachment to the mandibular neck and then is reflected upon the bone to end at the posterior boundary of the articulating surface of the condyle.

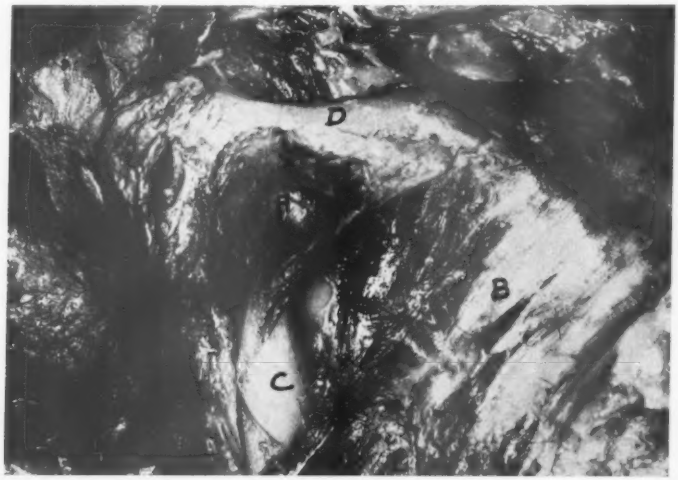


Fig. 5.—Photograph of a dissection of the temporomandibular ligament. *A*, Temporomandibular ligament. *B*, Masseter muscle. *C*, Ramus of the mandible. *D*, Zygomatic process of the temporal bone.

All specimens show clearly the separation of the superior and inferior heads of the lateral pterygoid muscle. The superior head originates from the infratemporal surface of the greater wing of the sphenoid. The inferior head, which is the larger, originates from the outer surface of the lateral pterygoid plate.

The fibers of the inferior head converge upward, backward, and laterally to insert in a rough fovea on the anterior surface of the mandibular neck. The fibers of the upper or superior head run backward, laterally, and slightly downward in very close relationship with the base of the cranium. The entire lateral part of the superior head and a variable number of fibers of its medial part are attached to the mandibular neck and not the disc. However, the medial and superior bundles of the upper head of the lateral pterygoid muscle are attached to the medial anterior corner of the fused capsule and disc (Figs. 6, 7, and 8).

DISCUSSION

The disc has been described in the literature as a biconcave plate because it is almost always seen in a sagittal section, but this is not a true picture. The

Fig. 6.—Photograph of a dissection demonstrating the insertion of only the most medial and upper part of the superior head of the lateral pterygoid muscle to the medial anterior corner of the disc. *A*, Articular disc. *B*, Superior head of the lateral pterygoid.

Fig. 7.—Photograph of a dissection demonstrating the insertion of only the most medial and upper part of the superior head of the lateral pterygoid muscle to the medial anterior corner of the disc. *A*, Medial anterior corner of the disc. *B*, Medial and upper part of the superior head of the lateral pterygoid muscle. *C*, Mandibular condyle.

upper surface of the disc is saddle shaped, concave anteroposteriorly, and slightly convex mediolaterally, while the lower surface is a concave ovoid. The saddle shape of the upper surface is, of course, an adaptation to the

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shape of the eminence, which is strongly convex anteroposteriorly but slightly concave mediolaterally. Ackermann's[1] description of a superiorly convex posterior part of the disc, adapted to the concavity of the fossa, was not found to be correct. The error evidently is caused by visualizing the retrodiscal pad as part of the disc itself.

Rees[2] divides the disc into four zones or bands. While the anterior three bands can be separated only arbitrarily, the fourth posterior zone is not part of the disc but of the loose connective tissue attaching the disc to the capsule. However, the division of the disc proper into three bands adds nothing to our understanding of the structure of the disc and its shape. It is merely the expression of the well-known fact that the borders of the disc are much thicker than the central zone.

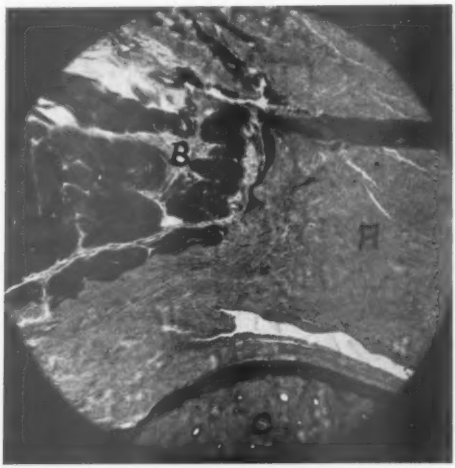


Fig. 8.—High-power view of the superior head of the lateral pterygoid muscle inserting into the disc. *A*, Articular disc. *B*, Superior head of the lateral pterygoid. *C*, Mandibular condyle.

The disc is fused anteriorly to the capsule, which allows for the insertion of muscle fibers into it. Posteriorly, it is attached to the capsule by loose connective tissue. The attachment of the disc by this loose connective tissue, or retrodiscal pad, is indispensable for the extensive forward movement of the disc with the condyle.

Medially and laterally, the disc is not connected with the capsule at all. The independent attachment of the disc to the medial and lateral poles of the condyle was first described by Krough-Poulsen and Moelhave.[3] The studied material allows a confirmation of their findings. This relation of the disc to the condyle may have been seen previously, but it has been misinterpreted. Arstad's[4] deep capsular ligaments seem to have been the direct attachment of the disc to the condyle. Rees's second zone or band of the disc also seems to comprise not only the middle area of the disc but also its medial and lateral fibrous attachments to the condyle.

The traditional explanation of the simultaneous movement of disc and condyle rests upon the attachment of the lateral pterygoid muscle to mandible and disc. This explanation, however, appears more than doubtful, since the retrusive movement of the disc with the condyle cannot be explained by muscular action on the disc. Since the disc evidently follows automatically the retrusive movement of the mandible, it is only logical to assume the same mechanism for the protrusive movement. The attachment of some fibers of the lateral pterygoid muscle to the disc has to be interpreted as serving a stabilizing function. It has been known that during mastication the mandible itself is held in position on the posterior slope of the eminence by the coordinated action of the lateral pterygoid muscle and the closing muscles of the mandible. The equilibrium between disc and mandible and between disc and eminence is maintained by the muscle attachment to the disc itself.

The relations of the disc to the capsule and the condyle in different areas have their specific functional significance. Fusion of capsule and disc anteriorly allows for an attachment of some fibers of the lateral pterygoid muscle to the disc in the service of stabilization during mastication. Direct attachment of the disc to the poles of the condyle not only explains the simultaneous movement of the two structures but also guarantees the proper relationship between condyle and disc, the condyle always riding upon the central nonvascular area of the disc. It is clear that only the latter is adapted to bearing pressure. Finally, the loose attachment of the disc to the capsule posteriorly allows its free and extensive forward movement in unison and in constant relation to the condyle. Claims by Landa[5] that the disc does not move as far forward as the condyle do not seem possible. Anatomically, the relation of the disc to the condyle forces the disc to follow all movements of the latter. Functionally, a lagging of the disc behind the condyle would force the condyle to leave the avascular, pressure-adapted zone of the disc to ride upon its vascularized anterior rim.

The attachment of the capsule to a broad area on the anterior rim of the postglenoid process prevents the condyle from coming into contact with the postglenoid process, and therefore it cannot be a fulcrum of the masticatory stroke, as was claimed by Murphy.[6]

Rees also points out that the temporomandibular joint has two ligaments —a lateral and a medial ligament—attached to it, as would be the case in any similar hinge joint in the body. One must remember, however, that the mandible functions as a unit and that neither joint acts independently. Therefore, the lateral ligaments of the two joints can be assumed to take the place of the two traditional collateral ligaments on either side of one hinge joint.

The relation of the superior head of the lateral pterygoid muscle to the disc is still controversial. Prentiss[7] claimed that the entire superior head of the lateral pterygoid muscle is attached to the meniscus; therefore, he calls it the sphenomeniscal muscle. Arstad's investigations led him to believe that there is no attachment of any fibers of the lateral pterygoid muscle to the disc. Most investigators are of the opinion that there is an attachment of some fibers of the superior head of the lateral pterygoid muscle to

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the disc.[8-17] This last description is borne out by our studies, but our findings enable us to be more specific. We found that only the most medial and superior fibers of the superior head of the lateral pterygoid muscle are attached to the medial anterior corner of the disc. This was ascertained only after very careful dissection and close observation of our specimens. These findings are in good agreement with the embryologic studies of Moffett,[18] who found that a small medial portion of the disc is derived from the posterior extension of the lateral pterygoid muscle.

All of the investigators who found fibers of the superior head of the lateral pterygoid muscle attached to the disc attributed the forward movement of the disc to the contraction of the muscle. Evidently, this attachment to the disc is not so much in the service of movement as in the service of maintaining the balanced position of the disc during mastication.

## CONCLUSIONS

The following conclusions were derived from our study:

1. The upper surface of the disc is saddle shaped, concave anteroposteriorly, and slightly convex mediolaterally to adapt to the saddle-shaped articular eminence. The lower surface of the disc is concave in both directions to adapt to the ovoid shape of the condyle.

2. Medially and laterally, the disc has a direct and independent attachment to the medial and lateral poles of the condyle. This attachment is by strong short ligaments comparable to collateral ligaments of a hinge joint.

3. The disc is fused to the capsule only at its anterior border. The posterior border was found to be continuous with a thick layer of loose connective tissue that provides the attachment of the disc to the posterior part of the articular capsule. This tissue can be termed the retrodiscal pad.

4. Only the medial and superior part of the upper head of the lateral pterygoid muscle is attached to the fused capsule and disc.

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## PHARMACOLOGY AND THERAPEUTICS

# AN EVALUATION OF THE ANALGESIC PROPERTIES OF A SALICYLAMIDE DERIVATIVE IN COMPARISON WITH A PLACEBO AND ASPIRIN

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*With the assistance of Olga Monomack*

In a previous study evaluating the pharmacologic and analgesic activity of various salicylamide derivatives in the rat, it was found that the N-dimethyl-3-phenyl salicylamide S2-426 had high "analgesic" potency when assessed by the animal's response to pressure or thermal stimulation.[1a] The present study, which was initiated following acute and chronic toxicity studies on S2-426, is concerned with the clinical evaluation of the analgesic properties of S2-426 as compared with those of a placebo and of aspirin in a group of dental patients with postoperative traumatic pain.

### METHODS

The subjects were patients suffering pain subsequent to standardized surgical and extraction procedures performed by senior dental students. The operative procedures, performed under local anesthesia, generally consisted of reflection of a soft tissue flap and removal of alveolar bone prior to extraction with forceps. The actual operation averaged about one-half hour in length. On discharge, each patient was given six capsules containing one of three forms of medication, the identity of the drug being unknown to the patient and to the operator. All three forms of medication appeared identical. The patient was instructed to take one or two capsules as required for pain. He was further instructed to return in two days and to bring back any of the drug which was not used. (We recognize that it would have been advantageous to evaluate the

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drug during the time of its effect, but the circumstances were such that this could not be practically effected.) On his return, the patient was interrogated about his condition and his response to medication.

The questioning was carried out by a neutral observer who entered the answers on a standardized questionnaire. It was first ascertained whether the patient still had any pain and to what degree. He was then asked about the pain he had experienced on the first day (excruciating, moderate, slight, or none) and the time during which the pain was most severe. He was also asked whether or not he had taken any analgesic agent. If an affirmative answer was received, the patient was asked how many tablets he took, at what time intervals, and whether or not relief was obtained and to what degree—that is, whether he obtained complete or partial relief or none at all. Information was obtained as to onset and duration of the drug's effect, the time intervals for repetition of the dosage, and the degree of relief obtained. The patient was also asked to describe any unusual effects of the drug, such as nausea, rash, dizziness, gastritis, etc. He was checked to make certain that no other medicinal agents were taken during this time interval.

A total of 297 subjects were given medication, but ninety-eight of the patients did not feel it necessary to take analgesic agents. Of the total of 199 who took medication, sixty-six received a lactose placebo, seventy-five received 0.3 Gm. S2-426, and fifty-eight received 0.3 Gm. of aspirin. The criterion of effectiveness of the drug was based on the patient's opinion concerning his condition and his response.

"Analgesia" was arbitrarily classified into three degrees. "Good" analgesia was used to describe complete relief from moderate or excruciating pain. The term "moderate" was applied to partial relief from excruciating pain or complete relief from slight pain. "Poor" indicated no relief from excruciating, moderate, or slight pain or partial relief from slight pain.

## RESULTS

The uniformity of the population in these experiments is indicated by an analysis of the degree of pain experienced by the patients in the three groups after a standardized surgical procedure. The results summarized in Table I

TABLE I. DEGREE OF PAIN IN DENTAL PATIENTS ON ANALGESIC MEDICATION

| MEDICATION | NUMBER OF PATIENTS | EXCRUCIATING | | MODERATE | | SLIGHT | |
|---|---|---|---|---|---|---|---|
| | | NO. | PER CENT | NO. | PER CENT | NO. | PER CENT |
| Placebo | 66 | 13 | 20 | 33 | 50 | 20 | 30 |
| S2-426 | 75 | 12 | 16 | 38 | 51 | 25 | 33 |
| Aspirin | 58 | 9 | 16 | 23 | 40 | 26 | 44 |

indicate that the random selection of subjects in the three groups yielded approximately the same percentage of patients in each group who experienced excruciating, moderate, or slight pain. The constancy and transient nature of the pain were also evidenced by the fact that when patients reported back after twenty-four hours, 94 per cent or more in each series reported that they

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had slight or no pain. It was usually stated, however, that the area was "sore" or "tender" rather than painful. It is also of interest that tooth extraction requiring bone flap removal is usually considered to create some need for postoperative analgesia; yet a very high number of patients (ninety-eight out of 299), felt that it was not necessary to take analgesic agents after the operation.

The responses of patients to analgesic agents are summarized in Table II.

TABLE II. RESPONSE OF PATIENTS WITH ANALGESIC MEDICATION

| MEDICATION | NUMBER OF PATIENTS | DEGREE OF ANALGESIA | | | | | |
|---|---|---|---|---|---|---|---|
| | | GOOD | | MODERATE | | POOR | |
| | | NO. | PER CENT | NO. | PER CENT | NO. | PER CENT |
| Placebo | 66 | 18 | 27 | 29 | 44 | 19 | 29 |
| S2-426 | 75 | 24 | 32 | 34 | 45 | 17 | 23 |
| Aspirin | 58 | 19 | 33 | 27 | 47 | 12 | 21 |

It is interesting to note the high degree of response to placebo in this series of patients. Twenty-seven out of sixty-six subjects receiving a placebo claimed that they obtained complete relief from moderate or excruciating pain. This high placebo response in this type of patient makes it extremely difficult for us to evaluate the analgesic effect of such agents. Although S2-426 gave good relief in twenty-four out of seventy-five patients, this response was no better than that obtained with a placebo. In fact, although the analgesic effects of aspirin are well known, in this particular series of subjects it was not possible to distinguish aspirin from a placebo. There appeared to be no striking differences in onset and duration of effect of the three forms of medication. In those cases in which analgesia was obtained, relief with all three agents was reported as early as ten minutes after ingestion of a capsule and it occurred generally within one hour. The duration of effect reported ranged from one to eight hours, with most subjects indicating between three and five hours.

There was an extremely low incidence of side reactions with all three forms of medication. No serious undesirable reactions were reported. All complaints were minor in nature. In the sixty-six patients given a placebo, there was a total of nine complaints—three cases of dizziness, two cases of drowsiness, two cases of nausea, one case of itching, and one case of sweating. In the seventy-five patients on S2-426, there was a total of eight complaints—four cases of dizziness, two cases of drowsiness, one case of gastritis, and one case of sweating. In the fifty-eight patients receiving aspirin, there were three complaints—one case of nervousness, one case of headache, and one case of nausea.

## DISCUSSION

These studies have shown the difficulties encountered in evaluating a patient's response to an analgesic drug. Other investigators, in similar studies, have recognized this problem.[1, 2] An attempt was made to tabulate as accurately as possible the responses of the patients to the analgesic drugs and to a placebo in the control of postextraction pain. The patients were unselected, and the double-blind method was employed.

Sonnenchein and Ivy,[4] in reporting on a pain-threshold study, state: "Any significant effect of the antipyretic drugs on normal human pain threshold is due to a placebo effect, i.e., suggestibility." In other controlled studies on postoperative oral surgery patients[2, 3, 5] a high placebo response has been reported. In this study it appears that aspirin, placebo, and the salicylamide derivative under investigation did not differ significantly in the control of postoperative pain. Suggestion apparently plays a large role in the patient's response.

Because of the large number of patients who returned all the capsules, we must consider how much need there was for an analgesic in some of the favorable responses. However, this does not mean that it is not necessary to prescribe medication for the control of postoperative pain in all cases after the removal of teeth. The patient's comfort and welfare should be the governing factor, with the operator recognizing the role of suggestion when prescribing medication for postoperative comfort.

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# ORAL ROENTGENOLOGY

*American Academy of Oral Roentgenology*

*Arthur H. Wuehrmann, Editor*

## A ROENTGENOLOGIC REBUTTAL

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IN THE past several articles have been published in which some rather incomplete, inaccurate, and misleading statements have been directed at right-angle roentgenography using the extension cone. This rebuttal is an attempt to throw some light on the confused picture that has resulted and to provide help in evaluating such misinformation.

The sequence will not necessarily indicate the relative importance of the points considered. Of course, it is possible to rebut only specific criticisms of right-angle roentgenography. Those that are merely generalized will, of necessity, be disregarded. Then, some statements have been so hopelessly mixed up that any attempt to straighten them out would be destined to failure. For these, only a restatement of the principles upon which right-angle roentgenography using the extension cone is based would suffice.[1]

First, it would be well to evaluate the criticism appearing in one article[2] that: "They [paralleling technicians] sacrifice numerous rules to their grim determination to have the x-ray angle projected at right angles to teeth and film." The specific rule referred to was that the film should be placed as close to the object being roentgenographed as possible.

The importance of this rule is not to be denied, and it would be adhered to without qualification if oral roentgenography involved only flat planes. All of the teeth and ridges have a greater or lesser third dimension, however, and portions of the dental tract, particularly those in buccoversion in the dental ridge and the zygoma, cannot be close to the film, no matter what technical procedures are used. Consequently, the rule should be qualified to read: "The film should be placed as close to the teeth and dental ridge *as practical.*" In right-angle roentgenography the film is placed close to the ridge in examining

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the mandibular molars because it is practical; elsewhere the object-film distance is increased as indicated anatomically, to achieve the parallelism desired and to avoid the unnecessary and undesirable procedure of bending the film. In analyzing this increase in object-film distance, it might be well to point out that the only appreciable increase is between the crowns of the teeth and the coronal part of the film, and usually this is only minimal for the apical portion of the film.

Increased object-film distance not only makes it possible to place the film parallel to the long axes of the teeth but offers other advantages which have proved helpful. The film is placed in the more spacious parts of the mouth, so that there is considerable latitude in shifting the film about for various oblique projections. The increased object-film distance also makes it possible, by taking advantage of the geometry of projection, to show more of the periradicular regions without using excessive vertical angulation.

Certainly, an increase in object-film distance is used in right-angle roentgenography but, as in medical roentgenography, it is done for certain purposes and as the practical thing to do. It is considered more important to show the shadow images of the dentition and associated and adjacent structures with anatomic accuracy and in their true relationship than to worry about violating a rule that can be more than compensated for by the use of some other time-proven roentgenographic factor.

Next there is the criticism that "increasing the film-object distance causes (a) enlargement, (b) distortion, and (c) loss of definition (blurring of the radiographic image)."[2] Also, there is the statement that "increasing the film-target distance corrects these defects, provided the film-target distance is increased enough—otherwise the damage to the image is not corrected."[2]

*Enlargement (commonly known as magnification and sometimes referred to as size distortion):* Since triangular projection exists in all planes of the x-ray beam, a degree of magnification is always present. How little or how much is partly dependent on the object-film distance. However, since within the confines of the oral cavity there are definite anatomic limitations that restrict the object-film distance range, the prime factor in controlling magnification is the over-all focal spot-film distance and not the object-film distance.

*Distortion:* There is size distortion or magnification, as already mentioned, but the use of the term "size distortion" in referring to such shape distortions as foreshortening and elongation is definitely misleading. Shape distortions result from an improper alignment of the object, the film, and the projected x-radiation—not from an increase in the object-film distance!

In one article,[3] reference was made to distortion in two experimental films made by Simpson. In the attempt to demonstrate enlargement, distortion, and loss of definition in the roentgenographic images by using object-film distances of ½ inch and 1¼ inches and a cone distance of 20 inches, Simpson apparently placed the planes of the wire screen and the film parallel and then directed the x-radiation at right angles to the two parallel planes, as is done in right-angle roentgenography. Upon enlargement of the images of the screens in the two

illustrations in Simpson's article, close examination reveals that the rounded corners of the wire screens have exactly the same characteristics in both, differing only in the degree of magnification or size distortion. Hence, it appears that the terms "distortion" and "magnification" have been confused. To complete Simpson's experiment, the above-mentioned images should be compared with those that result when the fundamentals of the bisecting and mathematical angulation techniques are used (Table I). With the latter techniques, such an experiment certainly would reveal progressive distortion in one plane as the object-film distance is increased, causing the square windows to become more and more rectangular; hence, actual shape distortion would be produced.

Shape distortion can be defined as the changing of the resulting shadow images so that they no longer represent the true shape of the object undergoing roentgenographic examination. If the object is actually square, there is a definite interpretive disadvantage in projecting its shadow so that the image in the film is rectangular. A distortion of this kind can be avoided and anatomic accuracy can be attained by maintaining the correct geometric relationship of the projected x-radiation to the object and the film.

If the 20 inch cone distance is used, magnification is minimal and uniform (even where the object-film distance is greatest) and definition remains good. When the short cone is used, there is an increased magnification of the images of the screen (especially on the parts of the film that have the greatest object-film distance) and a progressive loss of definition results.

In addition to the changes just described, if the film packet is bent in the manner sometimes prescribed for placement in the various regions, the images in the bent portion will be shown considerably distorted.[4]

TABLE I

| TECHNIQUE | MAGNIFICATION (SIZE DISTORTION) | SHAPE DISTORTION |
|---|---|---|
| Right-angle roentgenography using the extension cone | Minimal and uniform | None |
| Bisecting and mathematical angulation techniques using the short cone | Increased and not uniform | Usual, in proportion to deviation from the right-angle principle |

In so far as Simpson[3] went in his experiment to demonstrate distortion, he used an object with only two dimensions. For all practical purposes, this type of object is nonexistent in oral roentgenography where all objects have a third dimension. For instance, if a tooth is the object, instead of the screen, the films will show the images of the third dimension superimposed on different anatomic levels and with a distorted relationship as a result of the projection of the x-radiation through the tooth in an oblique direction.

*Loss of definition (also referred to as geometric unsharpness and diffusion of detail):* It is not clear just what is meant by "loss of definition," but the implication is definite that an increased object-film distance (and only this factor) is responsible for indifferent definition. No mention is made of the

size of the focal spot of the x-ray tube and the over-all cone distance as important factors in determining the quality of the definition in the roentgenographic images.

To quote a roentgenographic rule, *"The smaller the focal spot area, the better the definition, all other factors remaining the same."* We need only to consider the equation expressed in Fig. 1 to determine the degree of definition present. A consideration of this equation reveals that three factors in combination, not just one, affect definition. Consequently, the inference that "increased object-film distance causes loss of definition,"[2] without qualification or explanation, is misleading.

$$\text{Geometric unsharpness} = \frac{\text{(Focal spot width) (Object-film distance)}}{\text{Target-object distance}}$$

$$\text{or } u = \frac{w\,k}{f}$$

w = Width of focal spot (mm.)
u = Unsharpness (mm.)
f = Target-object distance (in.)
k = Object-film distance (in.)

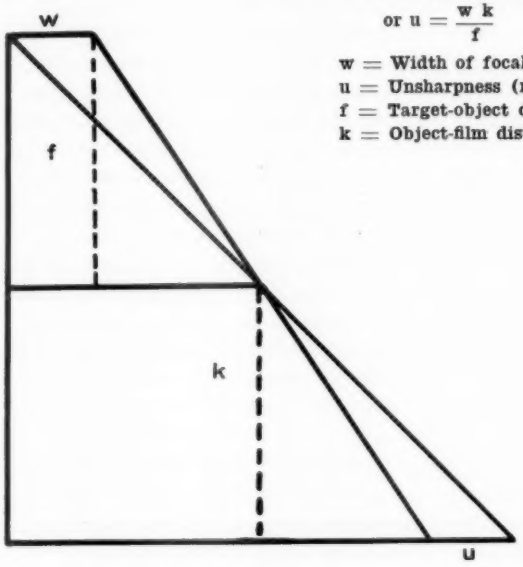


Fig. 1.

With the small focal spot areas available in our present-day dental x-ray equipment, the maximum definition can be obtained, regardless of the technical procedures and object-film distances used, by simply increasing the target-object distance with an extension cone.[5] In other words, the cone distance is increased purposely to gain the best possible definition of the fine detail that is to be interpreted. Since the focal spot areas are relatively small, it is practical to work within the 14 inch to 20 inch cone-distance range to secure this result. McCormack might have used less than a 36 inch distance, had he enjoyed the use of the present-day small focal spots.

In at least two articles other criticisms have appeared regarding the use of the names "extension cone" and "long cone" as applied to right-angle roentgenography.[3, 6, 7] The terms "long cone" and "long tube" are used

most commonly. Unfortunately these terms have, to a large extent, become a sort of symbol or "trademark" of the technique. In right-angle roentgenography, increased cone distance is accessory to clinical technical procedures. It is not a primary feature. If the emphasis is properly placed on the alignment of the object and film and on the projection of the x-radiation, the general term "right-angle roentgenography" can be used. To be more explicit, however, it is usually preferable to refer to the procedure as the "right-angle technique using the extension cone." This places the emphasis on the proper terms and indicates that the use of an extended cone distance is a secondary feature.

Some members of the profession have been led to believe what has been stated[3, 6, 7] in a rather oversimplified summary, namely, that it is necessary only to secure an extension cone and change to a fast film to use the right-angle technique. This statement completely overlooks the fact that differences in film placement and angulation are required to gain the desired results.[1]

Then there is the claim that: "Bisecting and mathematical technicians increase the film-target distance by choice, as a means of improving the quality of the radiographic image cast on the film. Paralleling technicians increase the film-target distance because they must, as a means of correcting distortion of the radiographic image caused by their use of a long film-object distance."[2, 3, 9, 10]

Increased target-film distance in right-angle roentgenography is neither more nor less a matter of choice than in the bisecting and mathematical angulation techniques. It simply makes possible the use of a principle, regardless of the technique employed, in order to (1) obtain maximum definition; (2) minimize magnification, especially of the shadows of the zygoma and nose; (3) obtain latitude in object-film distance without a loss of definition, making it possible to avoid shape distortion by projecting the x-radiation at right angles to the long axes of the teeth and to the film; and (4) reduce exposure to the patient's skin.

Other erroneous and/or conflicting statements, such as the claim that even the 20 inch cone distance does not correct the "damage," tend to becloud the issue.[3] This has led to the assumption that even if an operator changed to an increased cone distance, presumably to correct size distortion, the change would be futile and consequently not worth the effort. The foregoing statement is not consistent with the following from another article[7] by the same writer: "The authors, like all other radiodontists I know, readily admit that doubling (or substantially doubling) the conventional film-target distance of 8 inches improves radiodontic results—lessens magnification and gives a more distinct outline of radiographic images." With general agreement prevailing, as there appears to be, regarding the last statement, it is logical to assume that the first statement was made with a complete disregard for the "agreed-upon" advantages of doubling or substantially doubling the conventional cone distance. These same advantages are consistent with respect to improving the definition of the small structures and tissues in the dental tract, regardless of the technical procedures used. Increased cone distance is used in right-angle roentgenography for the same purpose that a 6 to 7 foot distance is used in medical roentgenography for a conventional chest film, that is, to show the fine detail with

the utmost definition. The advantages gained from the use of an increased cone distance are of great value in all phases of roentgenography—medical, dental, and industrial.

Minimizing image magnification offers the same advantage as using film of a larger size, namely, the scope of the film is increased. Also, collimation of x-radiation by the use of a standard diaphragm in the extension cone materially reduces the amount of secondary (scattered) radiation generated. Consequently, film contrast is not reduced by excessive secondary fog, and the visibility of detail in the roentgenogram is enhanced.

It was interesting to learn from another article[8] that "many bisecting and mathematical angulation technicians have been using long film-target distances for many years, with gratifying results." It is amazing to realize that these technicians, who have known of this factor and benefited from its use for thirty years or more, apparently have made little or no effort to inform the profession at large of these benefits or to urge the manufacturers to make changes in their x-ray equipment. The ready acceptance of this time-proven factor and the changes in x-ray equipment in recent years may indicate that the imparting of this information to the profession was long overdue!

It seems advisable to discuss only briefly other misconceptions of right-angle roentgenography that appear to need clarification. A paper read at an American Dental Association convention[9] consisted largely of a listing of the "disadvantages" of right-angle roentgenography. It is difficult to understand why the fundamentals involved were discussed in such a confused manner. It should be recognized, however, that if some authorities in roentgenology confuse these roentgenographic factors, certain physical and electronic factors, darkroom processing, and even film-mounting procedures with the techniques of right-angle roentgenography, those in the profession who may be less well informed are likely to become even more confused when they attempt to evaluate the statements made by these authorities.

The paper mentioned in the preceding paragraph, which was read but for some reason never published in complete form, referred primarily to the upper molar regions. It stated that there were four advantages and eighteen disadvantages to the long cone technique. Among the so-called disadvantages which have not been discussed earlier in this article were:

"There is less accuracy in determining the inclination of the teeth." If lay technicians can learn to determine the inclination of teeth accurately in a relatively short training period, this should not be difficult for professional people, especially since their educational background has included instruction in dental anatomy and osteology. If the bisection-of-the-angle technique is used, is it any less difficult to determine the inclination of the teeth? Where mathematical angulations are used, the inclination of the teeth and other anatomic variables apparently are not considered important!

"There is poor visibility of the film in the mouth." This is a misconception, since the film is positioned away from the teeth and is placed more in the middle of the palate for the upper molar regions in such a way that both sides of the film are readily visible.

"There is greater risk of film movement." Film movement and, of course, the patient who gags presumably will always present problems. However, since a film placed by any technique is susceptible to movement, it may be that the reference pertains to the film being placed with an increase in object-film distance. This is not a valid disadvantage, since film stabilization is an important phase of the film placement in right-angle roentgenography.

"There is greater difficulty in placing and maintaining the film in position in the palate; there is greater discomfort for the patient; and more patient cooperation is needed." If the increased object-film distance is achieved with cotton rolls and the film is held against the palate with the patient's thumb, an unskilled operator does encounter more difficulties in film placement. The cooperation required from the patient is about the same as would be necessary with any other type of film placement, with the possible exception of cases in which the wooden bite block is used. However, when the hemostat type of film holder is employed, the film is placed in and removed from the mouth much more quickly and with far less difficulty than with any other method. Most patients experience little or no discomfort, since the mouth is almost closed, and ordinarily the only cooperation needed from the patient is in closure of the jaws so that the teeth or ridges can hold the rubber bite block of the film holder. In actual practice, it is possible to place a film properly even if the patient can open the mouth no more than ½ inch, and it has not been unusual to secure good films with this instrument in the mouths of unconscious hospitalized patients.

"Increased secondary radiation results from the presence of the tongue in the path of the primary beam." This statement is pure misinformation. The tongue generates secondary radiation regardless of the technique used; it produces a lower level of secondary radiation than the hard tissues; and it rarely curls around the film adequately to produce an image. Furthermore, the short cone with the large beam produces a much higher level of secondary radiation from all tissues than the extension cone with an inherently smaller beam.[5]

"Decreased periapical coverage." Presumably this criticism was made because more of the diagonally projected periradicular regions and the zygoma are not shown and because all of the images are not foreshortened. Instead, is it not preferable to project the teeth and dental ridge accurately and the anatomic landmarks completely or partially, depending on their size and configuration, so that the interpretation does not have to be based on distortions and obscured detail? In addition, as previously stated, when the image magnification is greatly reduced, the coverage is automatically increased as though a larger film size had been used.

"Necessity of using two sizes of film." In other words, "To bend or not to bend; that is the question!" Is it better to bend and lose the effective coverage of the films and get distortions, or to use two sizes of film?

"More films are required." The implication here is that more time is required. Actually, it takes no longer to expose one film of good interpretive

quality than it does to take one of indifferent quality. The number of films is a matter of decision as to adequacy of the roentgenographic examination for diagnostic purposes. If the operator is a "picture taker" and always content to take routinely just a few or a set number of films for every patient, naturally he will resent the time required to take additional films necessary to render a more complete service. A lay technician who is restricted by a lack of dental training can be expected to do little more than a routine examination. The dentist, however, should be just as interested in complete roentgenographic examinations as he is in performing complete dental operations. Main,[11] in discussing the routine shortcomings of dental roentgenograms, places the blame on the failure to make sufficient exposures of a questionable region, on the tendency to obtain distorted images, and on haphazard roentgenographic and darkroom procedures.

"The technical procedures are too complicated for the general practitioner." Frankly speaking, this statement is not too complimentary to the dentist when the complexity of some of the technical procedures in modern dentistry is considered. The mechanics of right-angle roentgenography are not difficult or complicated. A great many dentists, dental students, dental hygienists, and lay technicians have been successfully trained in this technique during the past twenty years or more.

"The increased cone distance is not practical for use by the general practitioner." It certainly is agreed that a 20 inch, an 18 inch, or possibly even a 16 inch cone distance may be somewhat unmaneuverable in a small dental office. However, many operators are now using the 16 inch distance, and quite a few are using the 18 and 14 inch distances. Within the 14 to 20 inch distance range, there is adequate latitude so that almost any office can be equipped to provide a practical cone distance. It is important also to bear in mind that, since a fixed head position is not required, it is as easy to employ right-angle roentgenography with the patient in the supine or semisupine position as it is to perform certain other dental procedures and techniques. When the supine position is used, any cone distance out to the 20 inch limit can be readily employed.

"The plastic mounting procedures are too difficult for the general practitioner." Film mounting is important if films are to be studied and interpreted properly, but how it is done is a matter of practicability and personal preference. Plastic mounting has very definite advantages, but it is somewhat more time-consuming and more expensive. What may be practical for one practitioner is not necessarily practical for another. The plastic film-mounting procedures have never been considered a requirement for right-angle roentgenography.

Other so-called disadvantages of right-angle roentgenography include criticisms of characteristics presumed to be inherent in speed film. For example:

"The films are more contrasty." Since the degree of contrast controls the visibility of detail, contrast is considered a desirable feature. Experience has shown that long-scale contrast, that is, a long spectrum of grays between the black and white in the film, reveals the most detail, even in the darker areas.[8]

"The film packets are stiff; not easily bent and contoured." Bent and contoured film packets invariably show distorted images and crimp marks in the emulsion. In right-angle roentgenography it is not necessary to bend or contour the film, and the use of a flat film is a requirement, so that no portion of the recording emulsion shows uncontrolled distortions.

"The roentgenograms are apt to be deficient in sharp definition." Actually, with the extension cone the superimposition of the double images is closely approximated and a high degree of definition is secured. The typically apertured diaphragm collimates the beam so that there is considerable reduction in its divergence. With the short cone, however, there is likely to be considerable loss of definition when a double-emulsion film is employed. Since the beam of x-radiation from the uncollimated short cone is always greatly divergent, the images in the emulsion farthest from the x-ray tube are the largest. Consequently, the images in the two emulsions are not closely superimposed and a loss of definition results.

"The films have limited exposure latitude between under- and over-exposure." Naturally, there is less exposure latitude with fast films that require a short exposure than there is with slow films that require long exposures. While the exposure-time latitude is more limited, comparatively speaking, it is not excessively so, except possibly for the operator who works haphazardly. It is important only to bear in mind that the use of fast films makes short exposures possible and that short exposures will result in fewer moved films and a considerably lessened skin exposure for the patient.

"The films are difficult to develop by inspection." Any film, fast as well as slow, can be developed by inspection if the operator has the experience and the patience. This procedure, however, is difficult to teach; hence, the results achieved by an inexperienced operator are likely to be inconsistent. It is time-consuming in an unprofitable manner, and unscientific in approach.

"Films are fogged more easily by unsafe darkroom illumination than are regular or slower films." Fast films are inherently more sensitive to light, just as they are more sensitive to x-radiation. Certainly if the darkroom illumination is unsafe to begin with, it will fog almost any type of film, regardless of emulsion speed, and it follows that the fast film will show proportionately more light fog than the slower types of film. As any qualified operator knows, however, the need for adequate and safe illumination is a basic requirement in the darkroom.

"The films have objectionable graininess." When granule sizes for intermediate and fast films were examined at low magnification at a factory in New York, they were found to be identical for both types, but there were considerably more granules in the emulsion of the faster film. The greater number of granules may simulate graininess, but at the same time, since they allow greater recording latitude, the emulsion will record more detail. A critical inspection of films for graininess and detail can be made easily by mounting the films in slides and projecting them on a large screen.

In closing this rebuttal, it would seem important to call attention to a comparison of the results obtained by the two methods, as shown in Table II.

TABLE II

| RIGHT-ANGLE TECHNIQUE USING THE EXTENSION CONE | BISECTING AND MATHEMATICAL ANGULATION TECHNIQUES USING THE SHORT CONE |
|---|---|
| 1. The images of the dentition and associated and adjacent structures are shown with little or no distortion in shape or size and are depicted with their component elements unaltered in relationship | The images often are shown distorted in shape and size, and, except in bitewing films, their component elements are definitely altered in relationship |
| 2. Minimal and controlled superimposition of the images of adjacent structures, such as the zygoma and the nose | Great amount of magnified and uncontrolled superimposition of adjacent structures obscuring important interpretive detail, especially in the maxillary molar regions |
| 3. Maximum image sharpness (definition) of all structures, regardless of object-film distance | A lack of detail sharpness that is the general rule rather than the exception, especially of those structures that are inherently more remote from the film |
| 4. Increased periradicular coverage without the use of excessive vertical angulations | Increased periradicular coverage if the images of the teeth are foreshortened, and decreased coverage if the teeth are elongated by the vertical angulations |
| 5. Reduced skin exposure as a result of using an increased cone distance, a collimated beam, and a short exposure | An unnecessarily high skin exposure as a result of using a short cone distance, a large beam, and long exposures |

Comparatively speaking, it is not presumed that perfect results are always produced with the right-angle technique using an increased cone distance, nor are all anatomicotechnical handicaps completely eliminated. The technique does, however, mitigate these handicaps to a very large extent. This technique involves several factors which, when properly combined, yield the following desired roentgenographic advantages:

1. A truer depiction of the dental and associated and adjacent structures with unaltered relationships in the roentgenogram.

2. Maximum definition in the shadow images from using a combination of a small focal spot and increased cone distance.

3. Increased film coverage from materially reduced magnification.

4. Increased periradicular coverage from using an increased object-film distance.

5. Short exposures from using fast films; hence, fewer moved films.

6. Enhanced visibility of detail as a result of reducing the secondary radiation to a minimum.

7. Less skin exposure as a result of using a collimated beam, increased cone distance, and short exposures.

If oral roentgenography is to keep pace with the advances that have been made in other phases of dentistry, we must produce roentgenograms that consistently yield the greatest interpretive value obtainable. To do otherwise not only diminishes the usefulness of the roentgenographic examination, but it can cause an entire superstructure of diagnosis and subsequent treatment

to be raised on a very unsubstantial or erroneous foundation. The roentgenographic examination then becomes a source of error and misinterpretation. On the other hand, to provide an additional source of information and confirmation, we need only to take full advantage of the combination of a few technical procedures and roentgenographic factors which, by their characteristic behavior, produce roentgenograms with these interpretive qualities.

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# ROENTGENOGRAPHIC FOLLOW-UP OF SURGICALLY INTRODUCED INTRAMEDULLARY PIN IN THE MANDIBLE

## Report of a Case

*Duane W. Lovett, D.D.S.,* Iowa City, Iowa*

INTERNAL pin fixation of bone fragments has been an accepted procedure for more than two decades. The scientific investigation of this procedure in the late 1930's and early 1940's provided encouraging results and instigated expanded application of the pin type of bone fixation with wires and pins of the Kirschner and Steinmann types. The tendency of these pins to drift when retained over long periods of time or in permanent placement has received considerable discussion. The following case report records the drift of a free intramedullary pin in the body of the mandible.

### CASE REPORT

A 60-year-old white man, a mechanic, was admitted to the hospital with a diagnosis of epidermoid carcinoma on the floor of the mouth, at the base of the tongue, and in the anterior tonsillar pillar (right side). He weighed 150 pounds and was 5 feet 8 inches tall.

Fig. 1.

Fig. 2.

Fig. 1.—Intramedullary pin position on Sept. 9, 1957.
Fig. 2.—Intramedullary pin position on Feb. 27, 1959.

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Therapy consisted of right radical neck dissection with en bloc removal of the base of the tongue, the tonsillar pillar, and the tonsillar fossa on the right side. To provide surgical access to all areas of the lesion, the right body of the edentulous mandible was transected in the molar region. The mandible was reunited by means of a short Steinmann intramedullary pin with interosseous wire ligation of the fragments. No other mandibular

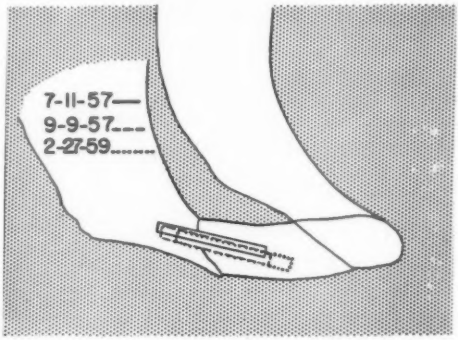


Fig. 3.—Composite tracing showing pin positions on July 7, 1957, Sept. 9, 1957, and Feb. 27, 1959.

fixation was used. Recovery was uneventful, and healing was normal. Fig 1 shows the position of the intramedullary pin fifty-seven days following placement, and Fig. 2 shows the pin position seventeen months following placement. Fig. 3, a composite tracing from the roentgenographic follow-up examination, shows the degree of pin drift in relation to the time interval. The pin tended to remain in a horizontal plane in the medullary tissue, with the drift taking place in an anterior direction. By superimposition of the first postoperative film and the last follow-up roentgenogram, using the posterior border of the ramus and the inferior border of the body of the mandible as landmarks, the measurable drift of the pin in seventeen months was found to be 1 cm.

## ROENTGENO-QUESTIONS

*Why are small carious lesions of the proximal surfaces of posterior teeth so much more difficult to demonstrate on dental x-ray films than the small carious lesions of anterior teeth?*

In x-ray studies of the posterior teeth we are studying the most dense tissues of the body, that is, the enamel. The amount of radiation which is absorbed in the dental tissues is related to density and thickness of the tissues. For 70 KVP units or lower, tissue density appears most critical; for 80 KVP units or higher, the volume of the object is the determining factor. Therefore, a small cavity 1 or 2 mm. in diameter on a posterior tooth may often have to be differentiated from several millimeters of overlying dense enamel. The difference in the amount of radiation absorbed in the area of the cavity, when compared with the intact enamel, may be so slight that the eye cannot detect the difference in film density. Anterior teeth, having less thick enamel in the path of the radiation, can be interpreted with greater accuracy in dental films because the ratio of enamel to caries is less than in posterior teeth. Also, the proximal surfaces of posterior teeth are much wider buccolingually, and any little deviation from the most optimum horizontal angle of ray projection through the interproximal space may result in superimposition of the small carious lesion over a larger volume of tooth enamel.

Film illumination is a second paramount factor in roentgenographic caries detection. Detail may be beyond the visual range under the best of lighting conditions if the film is too light. The interpretation of optimumly exposed or overexposed films will depend directly on the intensity of light used. A dense film with a long scale of contrast will record the earliest evidence of caries in the enamel, provided that proper light intensity is utilized.

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**The American Academy of Oral Roentgenology solicits from the readers of ORAL SURGERY, ORAL MEDICINE AND ORAL PATHOLOGY any questions which deal with technical or interpretive aspects of oral roentgenology. These questions should be sent directly to the editor of this section, Dr. Arthur H. Wuehrmann, School of Dentistry, University of Alabama Medical Center, Birmingham, Alabama; the editor will distribute them for reply to a suitable group within the Academy. Questions, with the answers, will be published at as early a date as possible in "Roentgeno-Questions." Questions, especially those of an interpretive nature, should ordinarily be accompanied by good-quality roentgenograms and a pertinent history. The names of the questioner and the respondent will not be published.**

## ROENTGENO-ODDITIES

### Periodic Roentgenograms Are Essential!

THE accompanying roentgenogram was taken when a patient was referred for upper right first premolar root canal therapy. Upon questioning, the 29-year-old white woman stated that as far as she could recall, the molar restorations had been placed about seven years previously. The great tragedy is not so much that this very large overhang occurred, although this is bad enough. The most condemning feature, however, is the fact that it was not discovered during the intervening seven years. Such severe destruction of the supporting tissues

could have been prevented. Only a roentgenogram could have revealed this condition; there were no subjective symptoms. (The negligence of the patient in not seeking dental attention must also be considered.) This case supports the necessity for taking periodic roentgenograms to check operative procedures.

*Manuel I. Weisman,*
*Augusta, Ga.*

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Each month this section will bring to the readers of ORAL SURGERY, ORAL MEDICINE AND ORAL PATHOLOGY one or more roentgenograms which demonstrate unusual, unexpected, rare, or bizarre roentgenographic changes. These roentgenograms will be accompanied by an explanation or by words of inquiry regarding the particular change. All films used in this section will be accepted with the understanding that 2 by 2 or 3¼ by 4 inch slides or glossy photographs of the films will be made available to interested readers through the editor of the American Academy of Oral Roentgenology at the individual's expense. The cost will involve only the photographer's charges. Each slide or print will give credit to the donor. Interesting roentgenograms are solicited from all sources. Please be certain to identify your films properly so that they can be returned. All material for publication should be submitted to Dr. Arthur H. Wuehrmann, University of Alabama School of Dentistry, Medical Center, Birmingham, Alabama.

# ORAL PATHOLOGY

*American Academy of Oral Pathology*

*Donald Kerr, Editor*

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## ORAL MANIFESTATIONS OF THE FITZGERALD-GARDNER, PRINGLE-BOURNEVILLE, ROBIN, ADRENOGENITAL, AND HURLER-PFAUNDLER SYNDROMES

*Robert J. Gorlin, D.D.S., M.S., Anand P. Chaudhry, B.D.S., M.S., Ph.D., and Elmer E. Kelln, B.S., D.D.S., Minneapolis, Minn.*

In 1958 we used the term "stomadrome" to signify a symptom complex that involved oral structures. The number of such syndromes is legion, and only a few will be discussed here.

### FACIAL OSTEOMATOSIS, FIBROMAS, EPIDERMAL AND DENTIGEROUS CYSTS, AND INTESTINAL POLYPOSIS (FITZGERALD-GARDNER SYNDROME)

This is one of the more recently described and consequently less well-known syndromes. Fitzgerald[1] first described it completely in the dental literature in 1943 when he reported a case in which there were, in addition, multiple compound odontomas of the mouth. Oldfield,[2] in 1954, reported an incomplete form of this syndrome in the British literature. Gardner and his co-workers[3, 4] independently described this syndrome in several papers in the 1950's and have contributed significantly to its exposition. They deserve full credit for bringing this syndrome to the attention of the medical profession. (Recent personal communication with Gardner has left us little doubt that he was unaware of the earlier report by Fitzgerald.)

Involvement of the maxilla, mandible, ethmoids, sphenoids, and frontal and zygomatic bones with multiple osteomatosis and, to a lesser extent, diffuse cortical changes of the long bones constitute the most striking change. The bony tumors expand the cortical plates and produce a chipmunklike appearance when the mandible is involved. Occurrence in the frontal and temporal bones produces hard irregularities and distortion (Figs. 1 and 2).

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The osseous thickening begins in childhood or adolescence and tends to become stationary in adulthood. It is usually bilateral. Microscopically, the bony growths consist of dense, mature cortical bone with well-marked Haversian systems. Cartilage has never been observed. Calcium, phosphorus, and phosphatase levels are always within normal limits. The most important facet of this disease, however, is the simultaneous occurrence of polyposis of the colon.

Fig. 1.

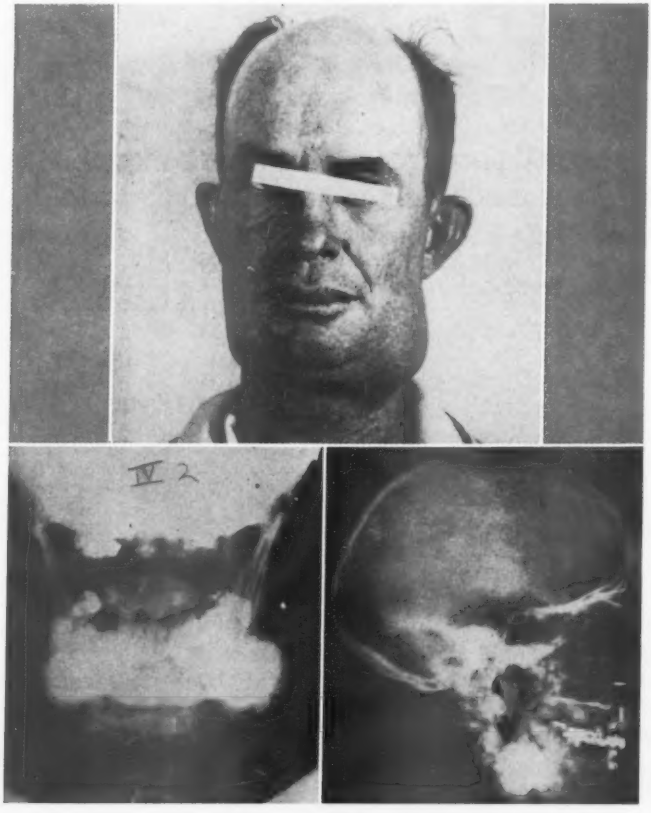



Fig. 2.

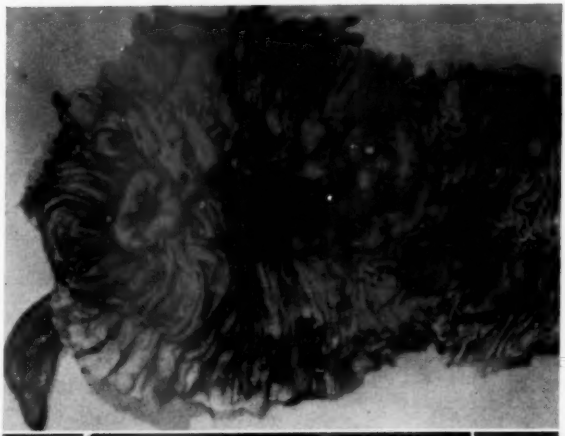
Fig. 1.—Fitzgerald-Gardner syndrome. Note chipmunklike appearance of lower face. (From Plenk, H. P., and Gardner, E.: *Radiology* **62**: 830-840, 1954.)

Fig. 2.—Fitzgerald-Gardner syndrome. Roentgenograms of patient seen in Fig. 1 reveal multiple osteomas, especially of mandible. (From Plenk, H. P., and Gardner, E.: *Radiology* **62**: 830-840, 1954.)

These polyps have a marked tendency to undergo malignant change (Fig. 3). The malignant propensity is much more marked than in Peutz-Jeghers syndrome,[34] in which the chief clinical complication is intussusception.

A third factor is the occurrence of epidermal and sebaceous cysts and fibromas. These can occur anywhere in the skin (Fig. 4).

Fig. 3.



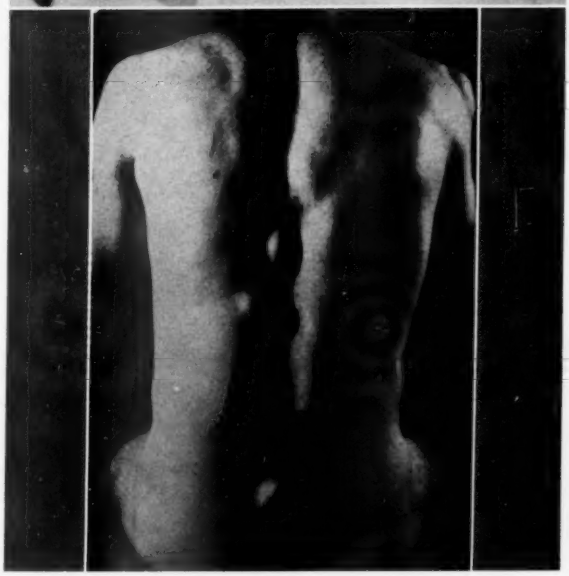


Fig. 4.

Fig. 3.—Fitzgerald-Gardner syndrome. Section of large bowel manifests numerous polyps which have a marked tendency to undergo malignant transformation. (From Plenk, H. P., and Gardner, E.: *Radiology* **62**: 830-840, 1954.)

Fig. 4.—Fitzgerald-Gardner syndrome. Fibromas (desmoid tumors) and epidermoid cysts are present over the dorsal region. (From Plenk, H. P., and Gardner, E.: *Radiology* **62**: 830-840, 1954.)

It is probable that a single dominant pleiotropic gene is responsible for all the facets of the syndrome.

### ADENOMA SEBACEUM WITH TUBEROUS SCLEROSIS, EPILEPSY, MENTAL DEFICIENCY, ETC. (PRINGLE-BOURNEVILLE SYNDROME, EPILOIA)

Many components are seen in this highly complex syndrome, the most common being (1) adenoma sebaceum, (2) epilepsy, and (3) mental deficiency. Most patients will be observed in institutions for the feeble-minded or epileptic.

Fig. 5.—Pringle-Bourneville syndrome. Note numerous small skin "tumors" about the nose, chin, and malar eminences. This patient is epileptic and mentally retarded. Observe the fibroma above the right eye.

The name "adenoma sebaceum" does not denote *true adenoma,* as the name might imply, but refers to a hyperplasia of sebaceous glands. Essentially, the same picture is seen in Fordyce's granules observed so commonly on the lips or buccal mucosa. In epiloia hyperplasia of the sebaceous gland begins in early life (at the age of 4 to 9 years) and occurs as nodules about the middle third of the face, especially about the naso-labial folds. Not uncommonly, the flesh-colored or yellowish nodules are surmounted by spider telangiectasia. Rarely, however, is the upper lip itself involved (Figs. 5 and 6).

The mental deficiency and epilepsy appear to be predicated upon the presence of glial nodules in the cerebral cortex (tuberous sclerosis). In addition to the aforementioned triad, there are subungual or periungual fibromas (Fig. 7) (especially of the toes), dystrophy or marked striation of the nails, large

flesh-colored "pigskin" plaques on the trunk, "shagreen" patches in the lumbosacral area, fibrous nodules of the skin (Fig. 8), abnormal pigmentation (café au lait spots, vitiligo, etc.), renal tumors (lipomas, angiolipomas, angiomyolipomas, adenomas, cysts, etc.), hepatic and/or pancreatic hamartomas, retinal

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 6.—Pringle-Bourneville syndrome. In another patient with epiloia, note small, raised, tumorlike growths.

Fig. 7.—Pringle-Bourneville syndrome. Subungual fibroma is commonly seen in this syndrome.

Fig. 8.—Pringle-Bourneville syndrome. Closer view of patient seen in Fig. 5. Note large fibroma above eyebrow and several small sebaceous nodules above inner canthus of eye.

tumors (phacomas), cardiac rhabdomyomas and/or large vessel anomalies, bony anomalies, imperfect genital development, etc.

Oral manifestations are fibromas, most commonly of the gingivae but occasionally of the tongue or palate (Fig. 9). No statistics exist concerning the frequency of such lesions. Sebaceous gland hyperplasia also occurs on the gingiva.

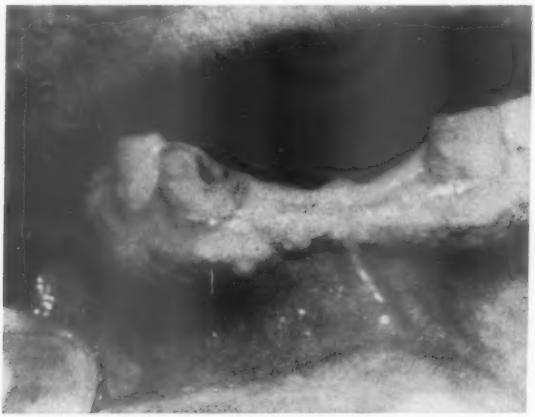


Fig. 9.—Pringle-Bourneville syndrome. Gingiva of patient seen in Fig. 6. Note numerous small fibromas on attached gingiva.

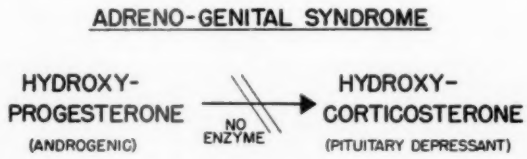
Fig. 10.—Pierre Robin syndrome. The patient manifests marked hypoplasia of lower jaw (micrognathia), cleft palate not involving his lip, and a tendency to swallow his tongue (glossoptosis).

The disease appears to be inherited as an incomplete dominant trait with equal sex distribution. It has been estimated that one in 200 cases of epilepsy is really a case of epiloia.

MICROGNATHIA, CLEFT PALATE, AND GLOSSOPTOSIS (PIERRE ROBIN SYNDROME)

Although called the Pierre Robin syndrome,[15] this symptom complex was described earlier by Lenstrup[13] and by Eley and Farber.[14] It consists of underdevelopment of the mandible (micrognathia) and cleft palate which, although usually complete, does not involve the lip (Fig. 10).[15-18] The small mandible allows the tongue to drop back into the pharynx (glossoptosis) and cause respiratory difficulties, usually cyanosis, when the infant patient is on his back. Nutritional problems are also commonly encountered, and the infant is usually fed by gastric tube. The disease may be associated with other congenital anomalies, such as tongue-tie (ankyloglossia).[19]

Fig. 11.



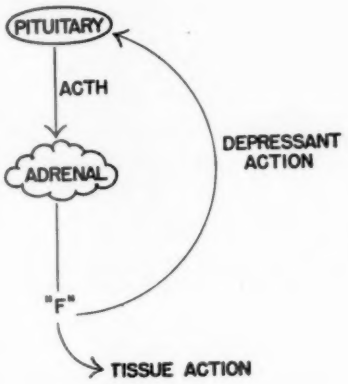




Fig. 12.

Fig. 11.—Adrenogenital syndrome. Because of the congenital absence of the enzyme which converts hydroxyprogesterone to hydroxycorticosterone, androgenic hormone is produced in great amounts producing pseudohermaphroditism in the female and virilism in the male.

Fig. 12.—Adrenogenital syndrome. Normal codependent action of pituitary-adrenal axis.

ADRENOGENITAL SYNDROME

The adrenogenital syndrome consists of premature skeletal and dental maturation, acne, pseudohermaphroditism in the female, and virilism in the male. The syndrome may be either congenital or acquired; the congenital type is usually predicated upon cortical hyperplasia, and the acquired state is usually predicated upon adenoma or carcinoma of the adrenal gland.[20-23]

Congenital adrenal hyperplasia seems to be due to an inborn inability to convert hydroxyprogesterone to hydroxycorticosterone as a mendelian recessive

trait (Fig. 11). Under normal conditions hydroxycorticosterone exerts an inhibitory effect upon the pituitary gland, but with a deficiency in this hormone the pituitary gland excretes large amounts of ACTH which, in turn, causes the adrenal gland to secrete large amounts of androgenic hormones (Fig. 12). Metabolized adrenal androgens are excreted in the urine as 17-ketosteroids, and excretion of more than 50 mg. in twenty-four hours in these cases is not unusual. (Normal values for the female seldom exceed 5 to 9 mg. per day, and for the male they seldom exceed more than 10 to 15 mg. per day. Below 10 years of age, values greater than 3 mg. per day are considered pathologic.) True sexual precocity in the male patient is not attained, however, as spermatogenesis does not take place. Skeletal growth, although premature, stops early due to epiphyseal closure and failure of sexual maturation becomes evident. In the female patient the male pubic hair pattern is observed and the clitoris is markedly enlarged. Although the internal genitals are normal, the vagina may be absent. Menstruation and breast development do not occur.

Fig. 13.—Adrenogenital syndrome. Hypertrophied clitoris of 7-year-old girl. Note single urogenital pore and early pubic hair.

The acquired type, caused by an adrenocortical neoplasm, is more commonly observed in female patients. While treatment of the acquired type of adrenogenital syndrome is largely surgical, the congenital form is best treated with cortisone, which inhibits the production of ACTH by the pituitary gland and thus reduces the adrenal output of androgenic hormone. In the congenital type the bone age is usually in advance of the dental age. Stafne's[20] case was in a 9-year-old girl whose bone age was 16 and whose dental age was 13. Several authors have made casual mention of precocious dental age, but we believe that Stafne was the first to furnish graphic proof. Prader and Maassen,[23] however, failed to note any dental precocity in nineteen cases that they reviewed.

A case of adrenogenital syndrome has recently come to our attention. Except for minor feeding problems, this female patient had no difficulty in

infancy. On Dec. 30, 1953, the patient's mother took her to a pediatrician because of an enlarged clitoris and the appearance of pubic hair (Fig. 13). At this time the girl was 3 years 1 month of age. Analysis of 17-ketosteroids revealed a level of 22 mg. per twenty-four hours. Roentgenograms of the wrists demonstrated normal carpal development at this time.

Both adrenal glands were explored, and hyperplasia of the left adrenal was found on Feb. 5, 1954. The pelvic organs were explored, and both ovaries were normal with small follicles present. The patient was started on 75 mg. of cortisone per day, and on March 23 the 17-ketosteroid level had dropped to 7.4 mg. per twenty-four hours. She was maintained on that dose, and on June 7, 1954, the 17-ketosteroids were down to 2.5 mg. and the cortisone was reduced to 25 mg. per day. The last 17-ketosteroid level on May 20, 1958, was 9.6 mg. per day, and the patient is still maintained on 25 mg. of cortisone daily.

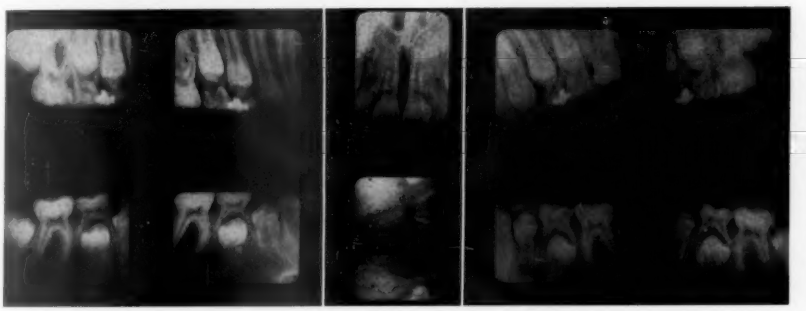


Fig. 14.—Adrenogenital syndrome. Dental roentgenogram of 7-year-old child. Dental age is approximately that of an 11½-year-old. Bone age was estimated at 13½ years.

In every other way the child's development has been perfectly normal. She has shown no evidence of precocious menstruation. Her growth has been slowed down, so that now she is only slightly larger than the other children in her school.

At the time we examined her, the patient's chronological age was 7½, her dental age was about 11½, and her bone age was about 13.5 years (Fig. 14).

### LIPOCHONDRODYSTROPHY (HURLER-PFAUNDLER SYNDROME)

Hurler-Pfaundler syndrome (dysostosis multiplex, lipochondrodystrophy, gargoylism) was fully described as an entity in 1919 by Hunter[30] and later by Hurler,[24] although several others had alluded to its existence. About 200 case reports have been recorded in the world literature, and several excellent reviews have been written.[25-29]

The characteristic signs of the syndrome are not apparent at birth, but they usually become apparent by the end of the first year of life. The most prominent features are dwarfism, a large head with a prominent forehead, saddle nose, lumbar kyphosis, hypoplasia of the second lumbar vertebra, hirsutism, limited

joint motion (*especially the temporomandibular joint*), umbilical hernia, enlarged liver and spleen, noisy mouth breathing, corneal clouding, mental retardation, and congenital heart disorders (Fig. 15).

There is characteristic enlargement of the shafts of the tubular bones with tapering of the bone ends. Reilly[31] demonstrated characteristic lilac-staining granules in polymorphonuclear leukocytes, lymphocytes, and plasma cells with Wright-Giemsa stain.

Oral abnormalities include thick lips, a large and protruding tongue, small and widely spaced malformed teeth, hypertrophy of gingiva and bony alveolar ridges, and limitation of jaw movement.

Fig. 15.—Hurler-Pfaundler syndrome. Dwarfism, saddle nose, umbilical hernia, and mental retardation are seen in gargoylism. Oral changes consist of thick lips, macroglossia, widely spaced malformed teeth, gingival hypertrophy, bony alveolar ridge enlargement, and limitation of jaw movement.

The syndrome is predicated upon the presence of abnormal substances within the central nervous system and in many organs and connective tissue. These substances seem to be a complex polysaccharide and a water-soluble glycolipid.[32, 33]

The syndrome is usually inherited as an autosomal (nonsex-linked) recessive trait. Far less commonly, it has a sex-linked recessive inheritance. It is more common in boys than in girls. As far as can be ascertained, no one who has the disease has procreated. Most patients do not live to adulthood, the majority dying of congestive heart failure.

We have had an opportunity to examine three patients with this syndrome (Table I).

## SUMMARY AND CONCLUSIONS

We have described five unusual syndromes involving one or more oral structures. The syndrome described by Fitzgerald and Gardner illustrates the important role which the oral diagnostician can play in the diagnosis of intestinal

TABLE I. FINDINGS IN THREE CASES OF LIPOCHONDRODYSTROPHY (HURLER-PFAUNDLER SYNDROME)

| | PATIENT D. D. | PATIENT J. S. | PATIENT S. B. |
|---|---|---|---|
| Age (years) | 6 | 7 | 5 |
| Sex | M | M | M |
| Family history | Negative | Negative | Grandmother's brother |
| *Physical examination* | | | |
| Dwarfism | +++ | ++ | + |
| Corneal opacity | + | 0 | 0 |
| Hearing loss | +++ | +++ | +++ |
| Saddle nose | +++ | + | ++ |
| Short, stubby hands | ++ | ++ | ++ |
| Hypertelorism | +++ | ++ | + |
| Umbilical hernia | Yes | No | No |
| Large lips | +++ | ++ | + |
| Large tongue | ++ | 0 | 0 |
| Temporomandibular joint immobility | ++ | + | + |
| Mental deficiency | ++++ | + | Normal |
| Mouth breathing | Yes | Yes | No |
| Small malformed teeth | 0 | 0 | 0 |

cancer. This role is also illustrated by the syndrome of acanthosis nigricans, which is not discussed in this article. Premature dental development characterizes the adrenogenital syndrome, and marginal cases may be suggested by oral findings. Both the Hurler-Pfaundler and the Pringle-Bourneville syndromes need much additional study by the orthodontist, the prosthodontist, and the oral surgeon.

The number of oral syndromes is large, and active study by the oral pathologist is needed.

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# ORAL MANIFESTATIONS OF CROUZON'S DISEASE

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In 1912 Crouzon[1] reported two cases of a disorder which was similar to cleidocranial dysostosis. Although the affliction resembled cleidocranial dysostosis, clavicles were present and there was extrusion of the eyeballs. As a result of his report, this syndrome became known as maladie de Crouzon or, more often, as Crouzon's disease or craniofacial dysostosis.

The prominent clinical features of the disease are (1) malformation of the cranium, that is, oxycephalia, in the area of the anterior fontanel and (2) underdevelopment of the middle third of the face, reducing the size of the orbital vault and causing marked exophthalmos. A change in the basilar skull development causes hypertelorism, described by Greig[2] in 1924. This change broadens the bridge of the nose and increases the distance between the eyes. The bones of the skull may show convolutional atrophy.[3]

Struma, brachycephaly, adenoids, hernia, dwarfism, spina bifida, saddle nose, middle-ear deafness, high palate, and torus palatinus have been associated with this disease.[2-5]

The mandible has a prognathic appearance as a result of maxillary micrognathia. The underdevelopment of the maxilla is most severe in the premaxillary area, usually causing a crowding of the maxillary teeth in the cuspid region. As a result of a smaller maxillary arch and a normal mandibular arch, the lower teeth occlude over the upper teeth in bucco- and labioversion (**Fig. 1**).

Concerning etiology, Crouzon[1] suggested that at birth the sutures of the cranial bones are inflamed, causing premature closure of the fontanels, early bone synostosis, and a latent period of cranial bone growth. Park and Powers[6] have suggested that a latent period of cranial vault development may cause mental retardation in some cases. Mann,[7] of England, suggested mesodermal dysplasia of the cranial bones to explain the maxillary micrognathia. Park and Powers[6] believed that the condition was due to a genetic defect in the anlagen of the cranial sutures. The frequent occurrence of this disease reported in successive generations suggests a familial pattern.

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In 1938 de Guntin,[8] in France, described severe dental anomalies, and in 1947 Andersen and Pindborg,[9] in Denmark, described Crouzon's disease associated with ectodermal dysplasia in which complete anodontia was exhibited. The inability to find cases in English citing oral manifestations prompted us to report the case that follows.

Pseudo-Crouzon syndrome was the name given by Franceschetti[10] to those cases which simulate Crouzon's disease but in which patients have impaired hearing due to a small, deep-seated eardrum.

Fig. 1.—Note severe underdevelopment of maxilla, causing false mandibular prognathism.

CASE REPORT

A well-nourished, 20-year-old white female patient of German and English ancestry was referred to the School of Dentistry, University of Minnesota, for orthodontic consultation. She was of average intelligence. About two weeks after her birth, which was uncomplicated, her parents became aware of the child's oddly shaped head. The patient did not walk until she was 18 months old. Her family history was noncontributory. Although she had average-sized parents and siblings, her adult height was 4 feet 10 inches.

*Extraoral Findings.*—The frontal bone was high, with a prominent eminence at the frontoparietal suture area (Fig. 2). The right frontal eminence and the right temporal bone were also prominent, causing a marked asymmetry of the face and head (Fig. 3). Right nasal septal deviation was also noted. The top of the head was flat, with pronounced sloping of the occipital region (Fig. 2). Marked exophthalmos was apparent, but vision was well corrected for astigmatism. Neither myopia nor hyperopia was present.

Body hair was scanty and thin, but perspiration was normal. Although the patient's mother stated that her pubic hair had a normal pattern, a masculine hair line in the frontal and temporal areas was conspicuous. The patient had heavy ankles and short feet, but her fingers and hands were of normal size.

*Oral Findings.*—The maxilla, as a whole, appeared to be underdeveloped, severe hypoplasia of the premaxillary area being most marked. The mandible appeared normal in size

but had a prognathic look because of the small maxilla. The hard palate was high and, although no clinical cleft was present, midline fusion appeared poor. The soft palate was firmer than normal, and there was a marked uvula bifida.

Oral hygiene was poor, masses of materia alba being present. The gingivae were hypertrophied and inflamed. The occlusion of the mandibular teeth was all buccal and labial to the maxillary teeth, producing the effect of the maxilla being submerged into the mandible (Fig. 1). All four third molars and maxillary first premolars were unerupted.

Fig. 2.

Fig. 3.

Fig. 2.—Note oxycephaly in frontal parietal region, underdeveloped maxilla, exophthalmos, and prognathic-appearing mandible.

Fig. 3.—Note prominence of right temporal region causing asymmetry of head. Also note exophthalmos and hypertelorism.

*Roentgenographic Findings.*—The roentgenograms demonstrated that the maxillary third molars, mandibular third molars, and the upper premolars that were clinically absent were fully formed and unerupted. No defect in root formation of any teeth was noted. Cephalometric analysis by Downs's method indicated an 8 mm. deficiency from the posterior condylar point to sella along the horizontal plane, and a 4 mm. deficiency from sella to the pterygomaxillary fissure. An 8 mm. deficiency in maxillary length and a 4 mm. deficiency in pterygomaxillary length were calculated, making a total deficiency of 24 mm. The clinically normal-appearing mandible also manifested a deficiency of 3 mm. along the lower border tangent. By subtracting 3 mm. from 24 mm., a 21 mm. net mandibular relative prognathism was obtained.

This maxillary hypoplasia may be explained on the basis of hypertelorism, direct relationship to premature synostosis of the base of the skull, or possibly mesodermal dysplasia. In any event, the underdevelopment of the middle third of the face is just as apparent roentgenographically as it is clinically. No convolutional atrophy was present.

## DISCUSSION

Any treatment that could minimize the effects of this malady would be of the utmost importance to the patient, from both the esthetic and the functional standpoints. Surgical intervention[11] in which polyethylene coverings are placed over the bone sutures to delay early fusion and to compensate for the expansion

of the brain during this critical development has been successful in delaying craniosynostosis in early infancy. No information is available concerning surgical, orthodontic, or prosthetic therapy in these cases to enhance occlusion and appearance, but thought has been given to the possibility that a surgical procedure to reduce the prognathism might yield a favorable result.

SUMMARY

A case of Crouzon's disease in a 20-year-old white female patient is reported. The oral findings in this case were an underdeveloped maxilla with primary emphasis on poor development of the premaxilla, a high and narrow palate, uvula bifida, unerupted teeth, faulty occlusion, hyperplastic gingiva, and everted lips.

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## ORAL PATHOLOGY

*General Section*

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# DILACERATION OF A MANDIBULAR PERMANENT INCISOR

## Report of a Case

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INJURY to the developing tooth germ is infrequent, as the tooth germs are well protected. The deciduous teeth are insulated from trauma by the bony crypts in which they form, and the permanent ones are protected either by crypts or by the roots of the deciduous teeth. Surgical trauma from the extraction of deciduous teeth rarely produces injury to permanent crowns, for the latter are usually completely formed before carious involvement is severe enough to require extraction. More common are deformities that result from the displacement of the partly formed tooth due to accidental fracturing of the maxilla or mandible[1] and other injuries sustained by children, particularly to the anterior part of the mouth. Glenn[2] has previously shown that injuries to the incisors of children most often accompany falls involving steps and sidewalks.

Sauntoné[3] experimented with cats, producing trauma at different stages of tooth development. The end result depended upon the stage of differentiation of the tooth germ at the time of injury. In early development, when cell differentiation had not progressed very far, the injured area of the enamel organ was replaced by undifferentiated mesenchymal cells. During later development of the tooth, at a time when dentine had been deposited, the injured part was repaired by the production of an osteoid substance. After the tooth tissue had completely differentiated, the lost dentine and enamel were replaced by young connective tissue from the dental follicle. If a calcified tissue was needed to restore the continuity of a tooth, osteodentine (rather than typical tooth substances) was always produced.

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Displacement of the partly formed tooth is not uncommon. The calcified portion of the unerupted tooth may be forced into the developing soft part, causing telescoping or a so-called impacted dislocation. In other instances pressure exerted either by the crowding of a neighboring tooth or by orthodontic means may force the partly or completely erupted tooth into a different location than that originally intended. If the root is not completely formed, the uncalcified part will bend, twist, or sometimes angulate sharply to result in the deformity known as dilaceration.[1]

An unusual case in which injury during infancy resulted in damage to a developing permanent tooth follows.

## CASE REPORT

At 18 months of age, patient G. W. G. (now 7 years old) fell on the sidewalk, striking the anterior section of the mandible. According to her parents, the labial alveolar plate of the mandible was fractured and was sutured into position. The available history did not indicate whether the deciduous incisors themselves were fractured, but they were apparently retained for some time. When the permanent lower right central incisor first began to erupt, the parents noticed that the tooth was developing in a "flattened position."

Fig. 1.—An intraoral roentgenogram. Note the bend of the tooth and the more opaque structure within the tooth that resembles a miniature tooth.

Clinical examination showed the crown to be erupting labially and in an almost horizontal position. The incisal edge protruded into the lower lip area when the mouth was in a closed, relaxed position. Incisal contact or function with the maxillary incisors when the jaws were in centric occlusion was not possible. The patient stated that the tooth seemed to be loose periodically and also that it was sensitive to cold beverages. On several occasions, because of the abnormal location of the incisal edge, the child injured her lower lip during play. Intraoral roentgenograms suggested a bend of the tooth at the cervical area of the crown (Fig. 1). Roentgenographically, the tooth also resembled a dens in dente. Because of the extreme anterior crowding, sensitivity, lack of function, and the fact that a crown preparation could not be accomplished without an unusual root canal procedure, the tooth was removed. The direction of force of the forceps was in line with the root and not the crown. Upon extraction, the incisor was noted to be boot-shaped, the crown apparently joining the root at almost a right angle (Fig. 2).

Microscopic examination revealed that the cervical point of the dentinoenamel junction extended into the center of the coronal pulp (Fig. 3). A large projection of osteodentine

Fig. 2.—The specimen is obviously boot-shaped in appearance. The cervical point of the dentinoenamel junction is located within the approximate center of the coronal pulp chamber. A large projection of osteodentine extends apically from the point of penetration. (Magnification, ×9, reduced ¼.)

Fig. 3.—A higher-power view of the specimen shown in Fig. 2. Point *a* originally joined point *b*. Remaining enamel matrix is seen at *e*. The dotted line represents the division between dentine formed before and after the traumatic episode. The delineation resembles a neonatal line as seen in deciduous teeth. Points *r* locate foci of resorption where odontoclasts were found. (Magnification, ×20; reduced ¼.)

reached apically from this point (Figs. 2 and 3). As illustrated in Fig. 2, point *a* originally joined point *b*. The sliver at point *e* is all that remained of the enamel matrix after decalcification. Except for the central projection of irregular dentine within the pulp, the remaining dentine was primary in character. However, there could be seen a division in the primary dentine of the crown (Figs. 2 and 3) which probably represented the amounts of dentine formation completed before and after the time of injury. This delineation gives the appearance of a neonatal line, as seen in deciduous teeth. The areas at points *r* revealed foci of resorption due to odontoclastic activity.

## DISCUSSION

According to Ellis,[4] the defect will appear at the junction of the crown and root or within the root of the tooth itself, depending upon the stage or age of development of the tooth at the time of the disturbance. In the case just described the almost 90 degree bend of the crown to the root gives interesting support to that premise. At the time of injury the tooth bud was bent in such a fashion that the cervical point of the dentinoenamel junction was evidently forced into the center of the pulp chamber at the cervical level. The pulp tissue, in response to the presence of this structure, laid down a large projection of osteodentine within the pulp chamber which created the illusion in the roentgenogram of a dens in dente.

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# AMELOBLASTOMA

## Report of Thirty Cases

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A BRIEF review of dental embryology is helpful in the study of the ameloblastoma. Enamel is derived from the ectoderm, and dentine, cementum, and pulp are derived from the mesoderm. The dental lamina is an epithelial plate which projects at a right angle from the labial lamina and extends into the substance of the embryonic gingiva. At intervals along the dental lamina the enamel organs develop as projections; these will serve as molds for the developing teeth and also will produce enamel. The enamel organ increases in size and its inferior surface comes in contact with a mesenchymal mass, causing invagination; in the end, the enamel organ is hollowed and forms a cup over the mass of mesenchyma. This mesenchymal mass will later become the pulp and dentine of the tooth.

During the first trimester the enamel organ develops into a double-walled sac consisting of the convex outer enamel layer and the concave inner enamel layer; between the two is the enamel pulp, composed of loose stellate reticulum. The outer enamel cells and the enamel pulp do not contribute directly to tooth formation, but the cells of the inner enamel layer become columnar and are known as ameloblasts.

In the study of the ameloblastoma, we are able to see types that resemble ameloblasts, stellate reticulum, and ordinary epithelial cells. Thus, it is possible that this tumor may originate from cellular components of the different stages of tooth development, from the most primitive to the mature-appearing ameloblasts, or it may develop from the undifferentiated epithelial cells and progress to more advanced differentiation while proliferating.

### INCIDENCE

The ameloblastoma is more prominent in the male, in the ratio of 2:1. It may occur at any age, but the majority of these tumors are seen in patients 25 to 45 years of age. The tumor is found more often in the mandible than in the maxilla, in the ratio of 7:1.

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TABLE I. REVIEW OF THIRTY CASES OF AMELOBLASTOMA

| CASE NO. | AGE | SEX | RACE | EXCITING FACTOR | ASSOCIATED WITH CYST? | LOCATION | INFLAMMATION PRESENT? | TREATMENT | RECURRENCE? |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 38 | M | Negro | Unknown | No | Mandible | Yes | Surgery and resection | No |
| 2 | 34 | M | Negro | Unknown | No | Mandible | Yes | Surgery and resection | No |
| 3 | 37 | M | Negro | Unknown | No | Mandible | Yes | Surgery and resection | No |
| 4 | 25 | F | Negro | Trauma | No | Mandible | Yes | Surgery and resection | No |
| 5 | 21 | M | Caucasian | Unknown | No | Mandible | Yes | Surgery and resection | No |
| 6 | 28 | F | Negro | Unknown | No | Mandible | Yes | Conservative surgery; no resection | Yes |
| 7 | 34 | F | Negro | Trauma | No | Mandible | Yes | Surgery and resection | No |
| 8 | 42 | M | Caucasian | Extraction | Yes | Mandible | Yes | Surgery and resection | No |
| 9 | 44 | F | Caucasian | Unknown | No | Mandible | Yes | Surgery and resection | No |
| 10 | 48 | F | Caucasian | Unknown | No | Mandible | Yes | Surgery and resection | No |
| 11 | 40 | F | Negro | Unknown | No | Maxilla | Yes | Surgery and resection | No |
| 12 | 24 | M | Negro | Unknown | No | Mandible | No | Surgery and resection | No |
| 13 | 26 | M | Negro | Unknown | No | Mandible | Yes | Surgery and resection | No |
| 14 | 40 | F | Negro | Unknown | No | Mandible | No | Surgery and resection | Yes |
| 15 | 38 | M | Caucasian | Unknown | No | Mandible | No | Surgery and resection | Yes |
| 16 | 44 | F | Caucasian | Unknown | No | Cheek | Yes | Surgery and resection | No |
| 17 | 31 | F | Negro | Trauma | No | Mandible | No | Surgery and resection | No |
| 18 | 27 | F | Caucasian | Unknown | No | Mandible | No | Surgery and resection | No |
| 19 | 22 | M | Negro | Unknown | Yes | Mandible | No | Surgery and resection | No |
| 20 | 40 | F | Negro | Unknown | No | Maxilla | Yes | Conservative | Yes |
| 21 | 35 | M | Negro | Unknown | No | Palate | Yes | Conservative | No |
| 22 | 31 | M | Caucasian | Unknown | No | Palate | Yes | Surgery and resection | No |
| 23 | 38 | M | Caucasian | Impaction (removal) | No | Mandible | Yes | Surgery and resection | No |
| 24 | 27 | F | Negro | Trauma | Yes | Mandible | No | Surgery and resection | No |
| 25 | 25 | M | Negro | Unknown | No | Mandible | No | Surgery and resection | No |
| 26 | 30 | F | Negro | Unknown | No | Mandible | No | Surgery and resection | No |
| 27 | 42 | F | Caucasian | Unknown | No | Mandible | No | Surgery and resection | No |
| 28 | 38 | F | Negro | Unknown | No | Mandible | Yes | Surgery and resection | No |
| 29 | 35 | M | Caucasian | Unknown | No | Mandible | Yes | Surgery and resection | No |
| 30 | 28 | M | Caucasian | Unknown | Yes | Maxilla | Yes | Surgery and resection | No |

ETIOLOGY

The actual cause of the ameloblastoma is unknown. The cell-rest theory, wherein any one of several tooth-forming tissues might contribute to the formation of this tumor, seems most plausible.

Other investigators have found a close correlation between the ameloblastoma and the follicular cyst. There is also a definite relationship between the follicle surrounding embedded teeth and the ameloblastoma. A number of case histories reveal an interesting relationship between the occurrence of the ameloblastoma and trauma from direct blows, extraction of teeth, and chronic infections.

Only the odontogenic theory of origin is considered here, since all the available evidence seems to favor this theory.

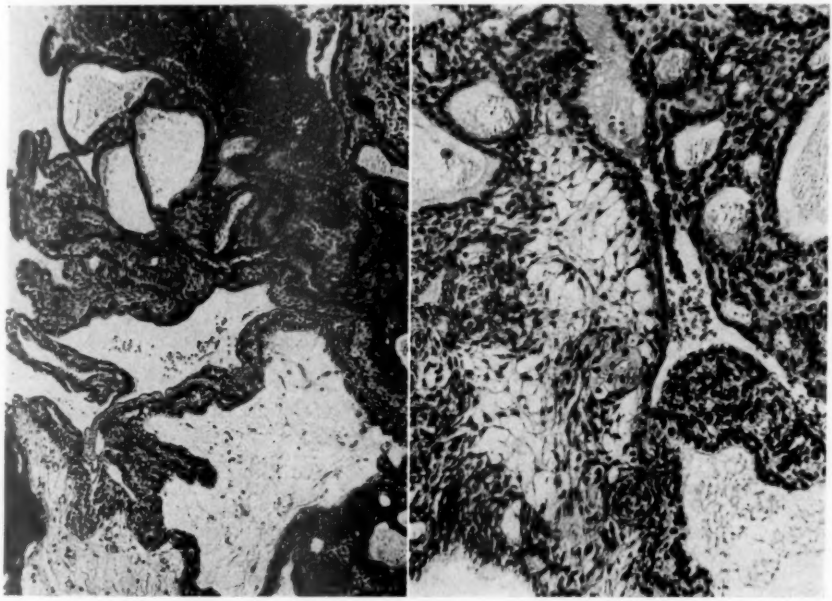

Fig. 1. Fig. 2.

Fig. 1.—Ameloblastoma. This is the typical form seen in most cases.
Fig. 2.—Enlargement of specimen shown in Fig. 1. Note regimented columnar cells and cells in the center resembling stellate reticulum.

GROSS AND MICROSCOPIC APPEARANCE

In gross appearance, ameloblastomas may vary from solid to cystic. The size varies and this tumor, though slow-growing, may become massive by expansion of the bony walls of the mandible. The tumor may originate in the gingivae, however, and have little bony invasion. As the tumor invades bone, it usually follows the vascular spaces, and bone destruction may be followed by fibrotic replacement.

Fig. 3.

Fig. 4.

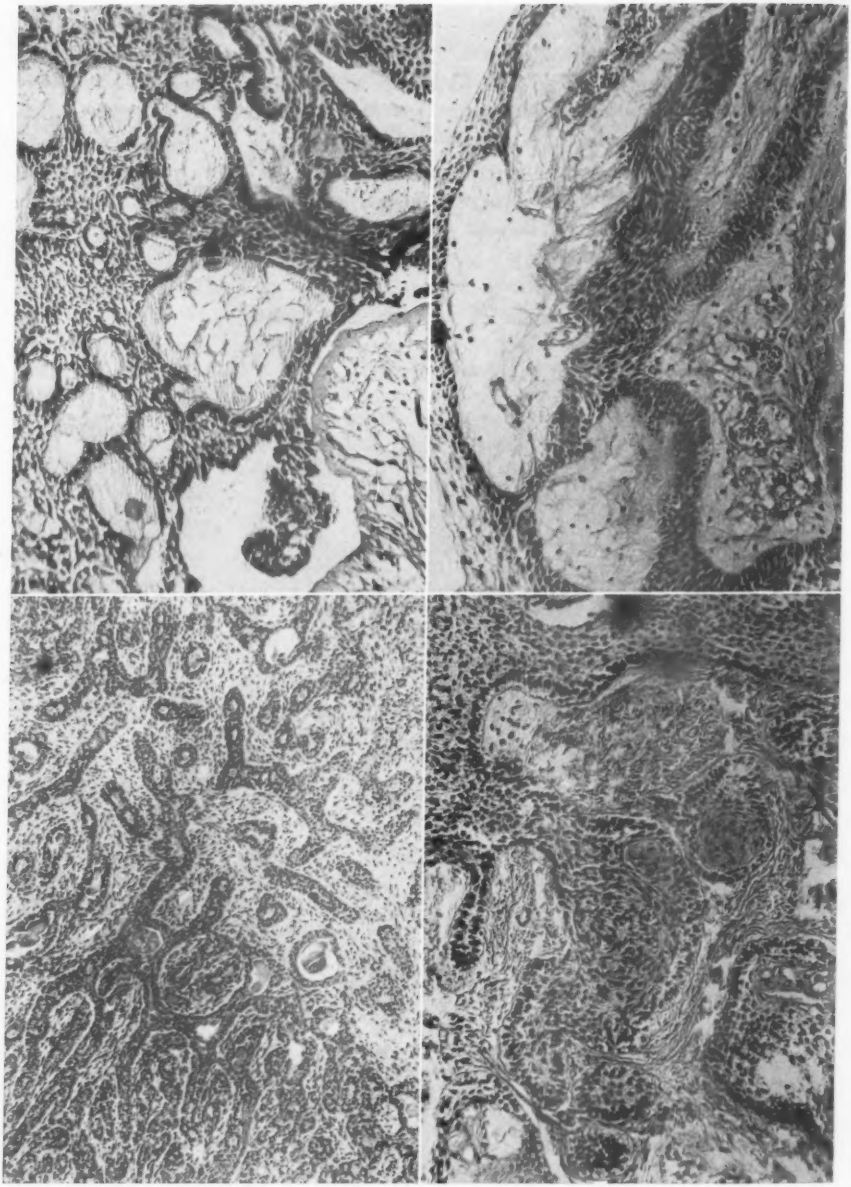

Fig. 5.

Fig. 6.

Fig. 3.—Adenoameloblastoma. Note the ductlike structures lined by a single row of columnar cells.

Fig. 4.—Ameloblastoma demonstrating cystic structure.

Fig. 5.—Solid ameloblastoma.

Fig. 6.—Ameloblastoma demonstrating squamous cellular elements.

The usual microscopic picture is one of a connective-tissue stroma with strands and islands of odontogenic epithelium. This epithelium may appear as squamous cells, cuboidal cells, tall columnar cells, or as the embryonic enamel-organ cells. In a great many tumors there are varying numbers of inflammatory cells due to secondary infection.

Bernier[3] describes the adenoameloblastoma, in which the odontogenic epithelium is arranged in ductlike structures. Another type described by Bernier is the acanthomatous ameloblastoma, in which the epithelium is made up predominantly of structures of the squamous cell type.

## TREATMENT

Eradication of the ameloblastoma is possible by surgical removal which, because of the invasive characteristics of the tumor, must include a margin of normal bone. In our experience with this tumor, conservative enucleation almost always results in recurrence.

In the case of early superficial lesions, partial resection of the alveolar ridge may be sufficient if a margin of normal bone is included on all sides. When there is massive involvement of the mandible or maxilla, resection is the treatment of choice.

Radiation has no place in the *treatment* of this tumor.

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# ENDODONTICS

***The American Association of Endodontists***

*Captain Warren J. Hedman, Editor*

## CLASSIFICATION IN ENDODONTICS

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OUTSTANDING among the purposes of the dental profession has been the effort to conserve teeth in a state of health and comfort. This has been true of those of our profession who have maintained a special interest in conserving teeth when pulps and associated tissues require attention.

Today there is a large mass of accumulated data on the subject. Science would have it systematized and formulated for the future. Therefore, there is an obligation to be concerned with the orderly arrangement of the data on endodontics.

### REASONS FOR CLASSIFICATION

A review of the literature reveals that endodontic data are largely unorganized.

The concept of endodontics has expanded greatly, so that the classifications of Grove,[15] Davis,[9] and other earlier writers are now found wanting. Little attention has been given the subject by later writers. There has been no consistent arrangement of the voluminous material on endodontics into a compact and agreed-upon systematic structure. This has led to considerable confusion. One finds evidence of discipleship to various schools of thought. Numerous articles are based on controversy. Much of the available material now in print is presented in heterogeneous fashion. The situation reminds one of the confusion which existed in operative dentistry before the work of G. V. Black.[3, 4] It is reminiscent of the confusion which confounded orthodontists prior to the time of Edward H. Angle. Angle[1] expressed his concern over the "endless variation which led to endless confusion in diagnosis and treatment among old school writers and practitioners." He pointed out that "all cases of orthodontia fall naturally into a very few easily and distinctly recognized groups."

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Black[3, 4] performed a similar service for dentistry by his classification of cavities and again by his presentation of a systematic approach to cavity preparation. He referred then to a situation in operative dentistry that prevails in endodontics today. This has to do with the gap which exists between knowledge and the use of knowledge.

With the rapid expansion[44] in the scope of endodontics, there have been some lags in concepts about it. Endodontics is still being conceived in a limited and fragmentary manner. It is more than treating or removing pulps. It is more than root canal therapy. It is more than performing apicoectomies. It is more than the sum of these and all other aspects combined. Among psychologists there is a theory that the whole, being composed of parts, is more than its parts. The whole may be thought of as a unique pattern or organization of its parts, in which case the whole has properties beyond those of its parts.

"A house has an architectural unity which is more than the materials of which it is composed."[16] Concurrently, endodontics is more than the sum of its parts. It does, however, lack architectural unity because it developed piecemeal, without benefit of blueprint.

## BENEFITS OF CLASSIFICATION

Although the horizons of endodontics are expanding rapidly, there is no generally accepted classification of endodontic cases. Selye[34] has stated: "Whenever a large number of facts concerning any branch of knowledge exists, the human mind feels the need for some unifying concept with which to correlate them. Such integration is not only artistically satisfying by bringing harmony in what appeared to be discord, but practically useful, as it helps to visualize a large field from a single viewpoint. It is only from there that we can see the field as a whole in order to establish where more careful exploration of the ground would be most helpful for its further development."

There are other benefits which would accrue from the classification of endodontic cases. Students would find the subject clarified and easier to grasp. Teachers would have a methodical basis for organizing teaching material. As Selye[34] has pointed out, areas are noted for continued study and research. Boards of dental examiners could more easily judge a candidate's theoretical and working knowledge of the field. Notice to dental colleges that examining boards intend to question more fully in this field would have a stimulating effect on the orderly teaching of endodontics. The object of classification is to suggest, leaving decision to the discretion and judgment of the operator. A classification table would help the practitioner discover the place that his particular problem occupies in the scheme, so that he might select those parts which are most appropriate to his use.[10] Classifications offer elements which may be accepted or rejected when compound situations are encountered. Different languages contain many treasures in science. Classification tables reduce efforts in translating into different languages.[11, 27, 38] Consequently, this would lead to more general use of endodontic services in many parts of the world.

METHODS OF CLASSIFYING

As a basis for classification of cases one turns to the basic sciences[7, 12, 17-19, 22, 23, 25, 27, 30-32, 35, 39, 42, 43] and to clinical practices.[5, 6, 8, 9, 11, 13-15, 20, 21, 24, 26, 28, 29, 33, 36-38, 40, 41] Endodontic cases may be classified by three separate means. The first is the histopathologic approach, the second refers to the kind of cases found upon clinical examination, and the third is based on the procedures of treatment. Accordingly, then, they are entitled histopathologic, clinical, and procedural classifications.

*Histopathologic Classification.*—The histopathologic approach to the classification of endodontic cases is concerned minutely and exactly with the biologic processes which affect the structure and function of the endodontic tissues. With the aid of the microscope, time-lapse studies reveal the kind and extent of changes undergone by tissues in health and disease. By means of experiment and clinical experience, biologic processes become understood and biologic requirements are established.

We are accustomed to understanding the phenomenon of inflammation and its sequelae as a process. We are used to associating causes with effects, and we have learned to anticipate the manner and degree of healing that follows treatment. Inflammation, however, is only one process among many. We are not in the habit of thinking of some phenomena as processes which may be taking place at the same time. Compound situations are more easily identifiable if they are brought to mind. The dominant processes observed in studies of endodontic cases—include growth, development, function, aging, inflammation, degeneration, local specific disease, general disease, neoplasms, and regeneration (Table I). Variation may be noted in the divisions of the table.

*Clinical Classification.*—Situations are encountered in the form of problems to be solved. Clinical endodontics should be regarded as a direct continuation of histopathologic study and not as a different field. Clinical astuteness is gauged by ability to correlate clinical findings and pathologic states. There are many situations that are recognizable under the microscope which the clinician cannot be expected to recognize. This constitutes one of the aforementioned gaps.

To be useful in everyday practice, classification and identity of case types should be simple. This is the case here, since there are but four classes which encompass the field. The first pertains to intact teeth, the second includes those teeth with exposed dentine, the third contains those teeth with exposed pulps, and the fourth involves teeth which were previously treated. Each class is divided according to age, anatomy, color, physiologic response of pulps (if there are pulps present), condition of the periodontal tissues, presence of specific local disease, general disease, and neoplasms (Table II).

*Procedural Classification.*—Having selected cases for treatment, the dentist must choose a procedure for treatment. The goal of endodontics is healing. Healing is achieved by means of a hard-tissue repair, although there are times when only soft-tissue healing occurs and is acceptable. It is also well known that healing can take place at various anatomic locations in vital pulp tissue

TABLE I. HISTOPATHOLOGIC CLASSIFICATION

*Class I—Growth*
1. Deciduous teeth
2. Permanent teeth
   (a) Incomplete root development
   (b) Completed root development

*Class II—Development*
1. Typical
2. Abnormal
   (a) Anomalies (gemination, fusion, dens-in-dente, etc.)

*Class III—Function*
1. Normal
2. Abnormal
   (a) Disuse
   (b) Occlusal wear
   (c) Trauma

*Class IV—Aging*
1. Continuous dentine deposition (includes extension of original dentinal tubules)
2. Abrasion
3. Interproximal wear
4. Root caries

*Class V—Inflammation*
1. Active hyperemia—rebound phenomena
2. Passive hyperemia
3. Pulpitis
4. Acute serous pulpitis
5. Acute suppurative pulpitis
6. Chronic ulcerative pulpitis
7. Chronic hyperplastic pulpitis
   (a) Without paradental involvement
   (b) With paradental involvement

*Class VI—Degeneration*
1. Calcific degeneration
2. Fibrous degeneration
3. Fatty degeneration
4. Internal resorption
5. Necrosis
6. Gangrene
   (a) Without periodontal involvement
   (b) With periodontal involvement
      Acute periodontitis
      Acute alveolar abscess
      Subacute alveolar abscess
      Chronic alveolar abscess, or granuloma
      Cyst
      Periodontal abscess

*Class VII—Regeneration*
1. Spontaneous
   (a) Fractured root tips
   (b) Rebound reactions of pulps
2. Following treatment
   (a) Repair of resorbed tissues
   (b) Repair by hard tissues
   (c) Repair by soft tissues

*Class VIII—Processes Simulating Periapical Disease*
1. Local specific (cementomas, periapical fibrous dysplasia, dentine dysplasia)
2. Local manifestation of systemic disease (hyperparathyroidism)
3. Neoplasms
   (a) Benign
   (b) Malignant

TABLE II. CLINICAL CLASSIFICATION OF ENDODONTIC CASES

*Class I. Intact Teeth*

Division 1: Age
1. Deciduous
2. Permanent
   (a) Incomplete root development
   (b) Complete development
   (c) Adult
   (d) Aged

Division 2: Anatomy
1. Typical
2. Abnormal (number of roots, variety of canals, fusion, gemination, dens-in-dente, other developmental anomalies)

Division 3: Color
1. Normal
2. Abnormal

Division 4: Positive Physiologic Response
1. Normal periodontal structures
2. Altered periodontal structures
   (a) Special local pathologic changes (cementomas, etc., internal, external root resorption)
   (b) General disease (hyperparathyroidism, etc.)
   (c) Neoplasms
   (d) Bifurcational involvement
3. Hyperemic pulps
   (a) Active
   (b) Passive
4. Inflamed pulps
   (a) Early—(−) heat, (+) electricity, (+) cold
   (b) Moderate—(+) heat, (+) electricity, (+) cold
   (c) Advanced—(+) heat, (−) electricity, (−) cold

Division 5: Negative Physiologic Responses
1. Normal periodontal structures
   (a) Extensive dentine formation (secondary dentine, hereditary opalescent dentine)
   (b) Damaged or removed nerves leading to the tooth (jaw fractures, trifacial neuralgia, etc.)
   (c) Nonvital pulps—(−) heat, (−) electricity, (−) cold
   (d) Pulpless teeth (canals empty or filled with fluids)
2. Altered periodontal structures
   (a) Special or local pathologic changes
      Periodontitis
      Acute alveolar abscess
      Subacute alveolar abscess
      Chronic alveolar abscess (may be apical, lateral, granuloma, cyst)
   (b) General disease

Division 6: Luxated
1. Laterally
2. Intruded
3. Extruded
4. Evulsed

*Class II. Teeth With Exposed Dentine*

(Class II contains all varieties of cases found in Class I plus those teeth involved with the conditions listed below)

Division 1: Erosion, Abrasion, Attrition

Division 2: Caries
1. Slight
2. Moderate
3. Deep

Division 3: Accidentally Fractured

Division 4: Preparation for Filling and Crowns

Division 5: Filled or Crowned Teeth

Division 6: Developmental Defects in Enamel

TABLE II—CONT'D

| | |
|---|---|
| | *Class III. Teeth With Exposed Pulps* |
| | (May be involved as in Classes I and II) |
| Division 1: | Intentional Exposure |
| | 1. Treatment |
| | 2. Experiment |
| Division 2: | Unintentional Exposure |
| | 1. Traumatic injury |
| | 2. Preparation for restoration |
| | 3. Erosion, abrasion, attrition |
| | 4. Caries |
| | 5. Resorption |
| | *Class IV. Previously Treated Teeth* |
| Division 1: | With Degenerating Vital Pulps |
| Division 2: | With Nonvital Pulps |
| | 1. Necrotic |
| | 2. Partial canal fillings |
| | 3. Fractured roots |
| | 4. Perforated roots |
| | 5. Root absorption |
| Division 3: | Without Pulps |
| | 1. Without pulps—canals filled |
| | 2. Canals overfilled with materials impossible to remove |
| Division 4: | Restored Teeth |
| | 1. With dowels |
| | 2. Strategic restorations |
| | (Cases appearing in Class IV may possess some features described in Classes I and II) |

and in tissues around the teeth. This being the case, treatment can be directed to produce healing at these various anatomic locations. In order to fix more firmly the idea that endodontic procedures and techniques of treatment may be directed toward the encouragement of healing at various anatomic sites, I devised a classification of endodontic procedures in 1952.[10] Seven years of teaching and practice, together with the experience of others, have strengthened my original thesis. The range of procedures encompasses the full scope of the field as indicated by the histopathologic and clinical viewpoints. The procedures of pulp protection, pulp capping, pulpotomy, pulpectomy, conservation of pulpless teeth, and repositioning of displaced teeth form the basis of the classification (Table III). Certain therapeutic adjuncts and surgical procedures are considered supplemental, and this is so noted.

## DISCUSSION

Examination of the three tables discloses that they are not alike in arrangement and content. The same classes, for example, do not pass neatly from one to another on the same horizontal plane. Although some of the features do appear repeatedly, clear-cut identity is not maintained. This does not invalidate the effort.

Achievement is based on knowledge, observation, and performance. Endodontics is a form of applied biology. It is knowledge made efficient through skill. One is reminded of the quotation: "The mind goes before the eye, the eye goes before the hand." Knowledge of histopathology aids observation.

TABLE III. CLASSIFICATION OF ENDODONTIC PROCEDURES

*Class I. Pulp Protection*

(To promote healing at the outer or inner ends of dentinal tubules and pulpal tissues)

Division 1: Treatment Applied to Dentine
- (a) Treatment of sensitive dentine
- (b) Insulation by impermeable cavity varnishes and cement bases
- (c) Treatment of infected dentine and insulation by impermeable varnishes, subbases, and bases
- (d) Sedative dressing to relieve vascular congestion of hyperemic pulps

Division 2: Treatment Applied to Pulp to Promote Healing at Location of an Exposure
- (a) Capping vital pulps (in cases of exposure under the rubber dam in undeveloped teeth)

*Class II. Pulpotomy*

(To promote healing at the gingival level of the pulp)
- (a) Removal of the coronal portion of normal pulp followed by medicated dressing, seal, and filling of the pulp chamber

*Class III. Pulpectomy*

(To promote healing within the foramina)

Division 1: Removal of the Entire Normal or Pathologic Vital Pulp, Sterilization, and Filling of the Root Canals

Division 2: Removal of Nonvital Pulps
- (a) Without periapical involvement
- (b) With periapical involvement

*Class IV. Conservation of the Pulpless Tooth*

(To promote healing in the foraminal, apical, and periapical tissues when involved)

Division 1: Removal of Products of Pulp Decomposition by Preparation, Sterilization, and Filling of Root Canals

Division 2: Removal of Previous Root Canal Fillings
- (a) Without periapical involvement
- (b) With periapical involvement

(Both divisions are managed by removal of pulps or previous fillings followed by preparation, sterilization, and filling of the canals)

*Conservation of teeth may be aided by supplemental therapeutics and surgery*

Supplemental Therapeutic Adjuncts:
- (a) Local (application of cold packs or hot irrigations and applications of drugs, heat, and light for bleaching discolored teeth)

Supplemental Surgical Procedure:
- (a) Lancing soft tissue for drainage
- (b) Creating an artificial fistula through soft tissue and alveolar process for drainage
- (c) Apical, lateral, or bifurcational curettage following root canal filling
- (d) Apicoectomy following conservative root canal therapy (may be delayed)
- (e) Apicoectomy following immediate sterilization and filling of root canals
- (f) Apicoectomy followed by immediate sterilization and filling of the root canals
- (g) Apicoectomy followed by immediate sterilization and filling of the canals from the apical approach
- (h) Sectioning of teeth (removing useless tooth roots and retaining useful ones following root canal therapy and filling; may be used for elimination of bifurcation commonly called hemisection)

*Class V. Repositioning Displaced Teeth*

(To promote healing at points of luxation)

Division 1: Partial Displacement (Lateral Displacement, Intruded, Extruded)

Division 2: Total Displacement
- (a) Replantation (replacement of evulsed teeth following removal of their pulps, sterilization, and filling of the root canal)
- (b) Transplantation (transference of a tooth from its socket to another; pulps are not removed from incompletely developed teeth)

It is easiest to see what we have been trained to see. Because of this, diagnosis and case selection are made more critically. The problem becomes more clearly defined. At such a point, the dentist may elect to treat each case according to his ability, skill, and inventiveness. Thus, by using one grouping after another, he has made serial use of each of the classifications. When the three classifications are joined in series and not in parallel, a blueprint of endodontics emerges. An architectural unity can be envisioned which is now complete enough to permit us to view the field broadly and to note many of its parts. Additional research and more clinical experience will fill in some of the gaps.

## CONCLUSIONS

It has been pointed out that:

1. There is a mass of data on the subject of endodontics.

2. There is some confusion among students, teachers, practitioners, and others because the data are not well correlated, arranged, and presented.

3. Some arrangement is desirable and necessary as a basis for case selection and as a guide in the selection of treatment procedures.

4. Classification of cases is possible by three approaches, namely, histopathologic, clinical, and procedural.

5. Classifications were formulated and presented in this article.

6. They are not alike. When utilized serially, however, each supports and enhances the value of the others.

7. This presentation has called attention to the need, value, and methods of classifying endodontic cases in the hope that it may serve as a stimulus for continuing effort toward improvement, elaboration, and perfection of the idea.

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## RESEARCH

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# EXPERIMENTAL PRODUCTION OF ORAL ULCERATIONS IN THE RAT

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### INTRODUCTION

SEVERAL years ago, Selye[1, 2] reported the production of a "progressive gangrenous stomatitis" in cortisone-injected rats whose lower incisors were repeatedly shortened to their level of emergence from the gingiva. Since uninjected control animals did not develop lesions of the oral mucosa, Selye concluded that the increased mechanical irritation following clipping of the incisors was not pathogenic per se. Only when the animal was subjected to an excess amount of an "antiphlogistic hormone," such as cortisone, did this "topical stressor" become pathogenic.

Because of the possibility that the pathogenesis of the "noma-like" lesions reported by Selye might be similar to the periodontal disease known as "acute necrotizing ulcerative gingivitis," an attempt was made to repeat these results in our laboratory.[3]

### MATERIALS AND METHODS

Sixty-four female albino rats, weighing approximately 125 grams each, were divided into four groups. The animals in Group I were untreated; those in Group II were given cortisone injections; in Group III the lower incisors were periodically shortened to the gingival margin with nail clippers ("cut down"); and the animals in Group IV were given cortisone injections and their lower incisors were cut down. Each day 2 mg. of cortisone† was injected subcutaneously. The lower incisors were shortened twice weekly.

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†Kindly supplied as Cortone acetate by Merck & Co., Rahway, New Jersey.

TABLE I. INCIDENCE OF EXPERIMENTAL LESIONS

| GROUP | NO. OF RATS | NO. WITH LESIONS |
|---|---|---|
| I | 20 | 0 |
| II | 16 | 0 |
| III | 13 | 10 |
| IV | 15 | 14 |

All animals were maintained on a stock ground diet *ad libitum*. One month later all animals were carefully examined for oral lesions and sacrificed. The lower jaws, including the gingiva, labial and buccal mucosa, skin, and tongue, were removed *in toto* and fixed in 10 per cent neutral formalin for subsequent decalcification[4] and routine histologic examination.

## RESULTS

Repeated shortening of the lower incisors produced deep ulcerations of the labial mucosa, gingiva, or tongue, regardless of cortisone treatment, whereas no lesions were found in animals whose lower incisors remained intact (Table I).

Fig. 1.—Ulceration of labial mucosa (arrow) in animal with cut-down incisors which did not receive cortisone.

Fig. 1 shows a gross ulceration of the labial mucosa in juxtaposition to the cut ends of the incisors in a Group III animal, in which the lower incisors were cut down and no cortisone injection was given. Histologic examination revealed a chronic, nonspecific ulceration with granulation tissue containing lymphocytes, monocytes, and plasma cells covered by a surface layer of polymorphonuclear leukocytes, fibrin, and necrotic debris. A moderate amount of edema was sometimes present in the tissue surrounding the ulcers (Figs. 2 and 3). Cortisone treatment did not alter either the gross or the microscopic appearance of the lesions (Figs. 4 and 5).

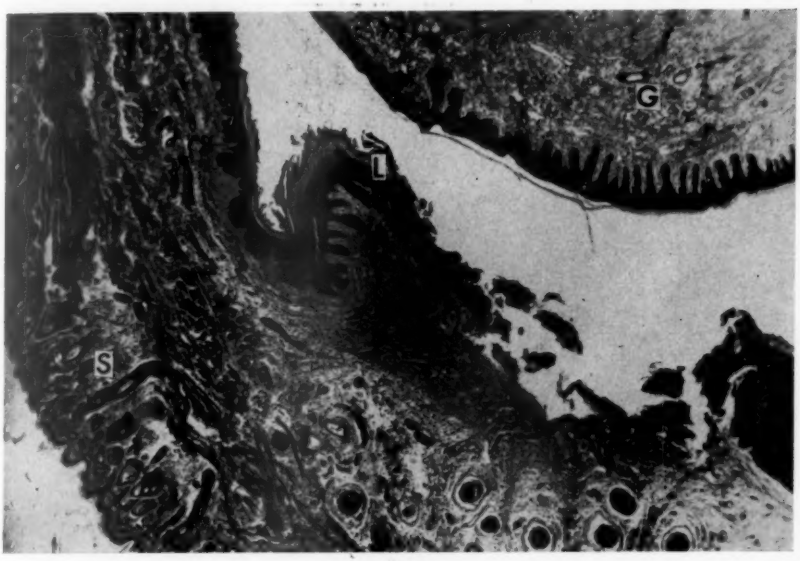


Fig. 2.—Horizontal section of lesion of labial mucosa in "cut-down" animal not treated with cortisone. Note necrotic ulcer base overlying acute and chronic inflammatory infiltrates *G*, Gingiva; *S*, skin of lip; *L*, labial mucosa. (Magnification, ×50; reduced ¼.)

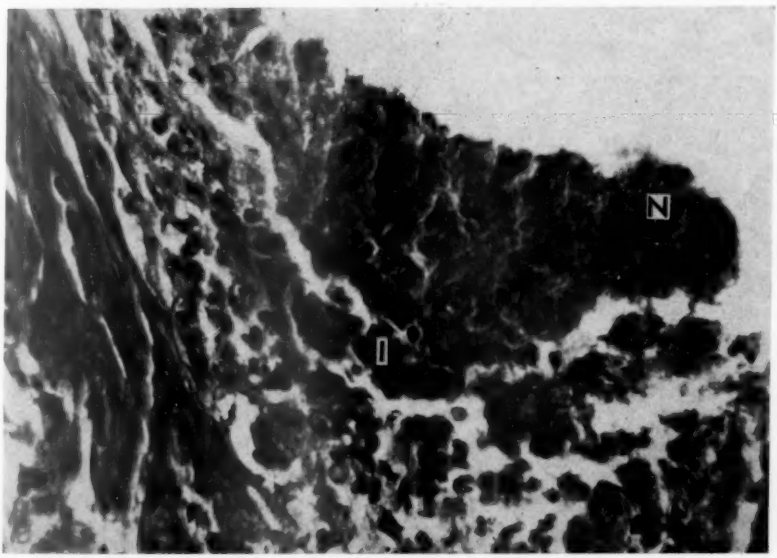


Fig. 3.—Same section as in Fig. 2, showing necrotic ulcer base and underlying inflammatory infiltrate. *N*, Necrosis; *I*, inflammatory infiltrate. (Magnification, ×650; reduced ¼.)

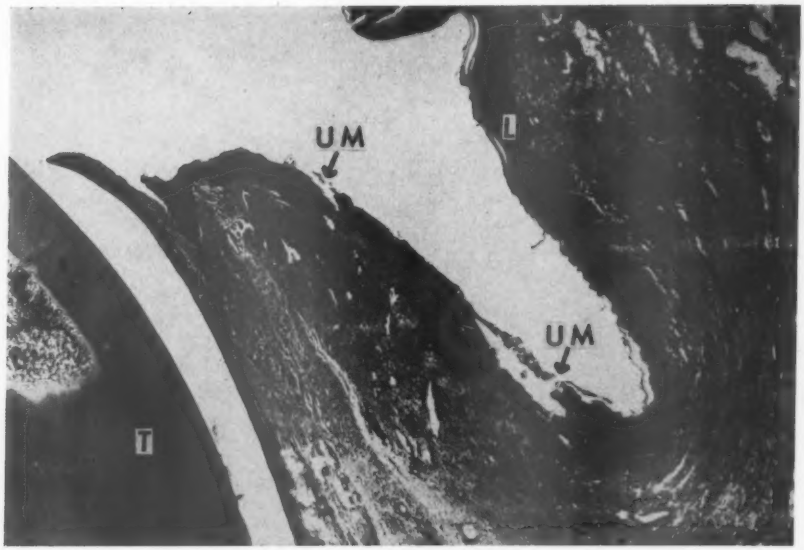


Fig. 4.—Sagittal section of lesion of attached gingiva and labial sulcus in cortisone-injected animal with cut-down incisors. Note inflammatory infiltrate underlying necrotic tissue at base of ulcer. *UM*, Ulcerated mucosa; *L*, labial mucosa; *T*, tooth. (Magnification, ×50; reduced ¼.)

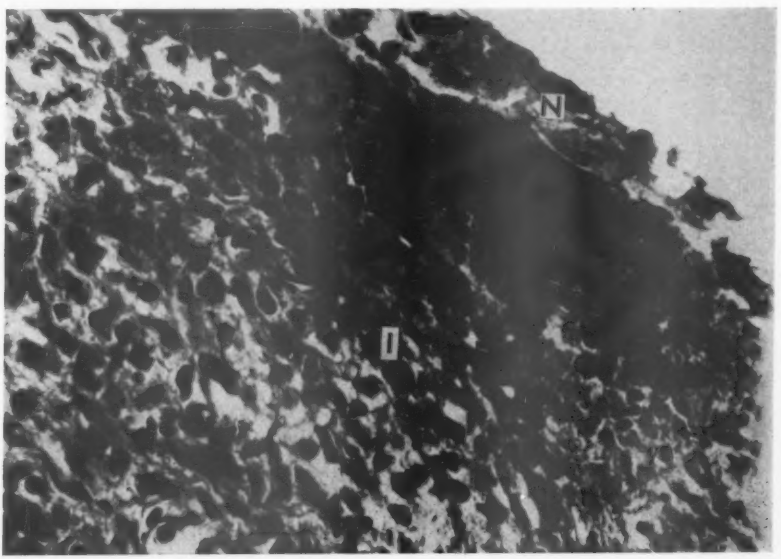


Fig. 5.—Same lesion as shown in Fig. 4. A moderate amount of edema is present, together with inflammatory cells beneath the necrotic ulcer base. *N*, Necrotic tissue; *I*, inflammatory cells with edema. (Magnification, ×650; reduced ¼.)

## DISCUSSION

The results suggest that the local irritation caused by the sharp tooth edge is the major factor in the production of oral ulcers concurrent with periodic cutting down of the lower incisors to the gingival margin. Systemic cortisone treatment did not appear to enhance this effect, since no "progressive gangrenous stomatitis" occurred in any animal. Only localized ulcerations of the labial mucosa, gingiva, and tongue were seen, even when the experiment was allowed to proceed for two months. Similar results were recently reported by Bundgard-Jørgensen and associates.[5]

In view of the well-known ability of cortisone to suppress the inflammatory response and wound healing, these results were surprising. Several explanations are possible. Shortening of the incisors may stimulate the *secretion of endogenous cortisone,* thereby masking any difference between uninjected and cortisone-injected animals. This seems unlikely, however, since the cutting-down procedure has been reported to have no significant effect on the weight of the adrenals,[6] suggesting that this procedure per se does not result in a significant increase in endogenous adrenal cortical hormones. *Bacterial infection of the ulcers* may have overcome the anti-inflammatory effects of cortisone, for Lattes and colleagues[7] found cortisone depression of repair to be nullified by spontaneous infection of experimental wounds. In their study, marked proliferation of granulation tissue was observed in animals treated with adequate doses of cortisone when the mechanical trauma of an irritant foreign body was combined with local bacterial infection. Conversely, they found that the most constant and marked inhibition of inflammation and repair by cortisone occurred in animals treated with daily injections of antibiotics. Along this line, however, the results of further work in our laboratory in which daily injections of 6,000 units of penicillin and 10 mg. of streptomycin were given were not significantly different from the previous results. The *presence of necrotic tissue* may have inhibited the effects of cortisone on inflammation and repair. Selye[8] has reported that the action of an antiphlogistic hormone may be overcome in the presence of both necrotic tissue and local irritation. While this situation did exist in our experimental lesions, necrotic tissue was also present in the "noma-like" lesions reported by Selye.[1]

At the present time, it is difficult to determine why our experimental results differ from Selye's. Such factors as differences in strain, housing, and handling of the animals may have contributed to the disparity.

## SUMMARY

1. Twice weekly the lower incisors of 125 gram female albino rats were shortened to the gingival margins with nail clippers. One-half of these animals received daily injections of cortisone. Cortisone-injected and untreated animals with intact incisors served as controls. All animals were sacrificed after one month.

2. Localized oral ulcerations of the labial mucosa, gingiva, and tongue were found exclusively in both groups of animals with cut-down incisors, regardless of systemic cortisone therapy. No "nomalike" lesions were observed. Neither the injection of a penicillin-streptomycin solution nor an extension of the experimental period to two months affected the incidence or extent of the lesions.

3. Histologic sections of the lesions showed a chronic, nonspecific ulceration with granulation tissue, lymphocytes, monocytes, and plasma cells covered by a surface layer of polymorphonuclear leukocytes, fibrin, and necrotic debris.

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## BACTERIOLOGY

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# ACTIVITY OF AMPHOTERICIN B AGAINST CANDIDA ALBICANS

## Disc Sensitivity Studies

*J. B. Campbell, Lucile Seguin, B.S., Austin H. Kutscher, D.D.S., and Edward V. Zegarelli, D.D.S., M.S., New York, N. Y.*

A NEW antibiotic, amphotericin B,[1-3] has recently been described as highly active against a broad spectrum of pathogenic yeasts and fungi, including *Candida albicans.*

Although clinical reports dealing with the treatment of *Candida albicans* infection with amphotericin B have now appeared in the literature, and although laboratory studies have confirmed the activity of amphotericin B against *selected* strains of *Candida albicans,* no study has as yet reported upon the presence or absence of sensitivity of a large group of *Candida albicans* organisms to amphotericin B. Nor does the literature suggest as yet whether discs impregnated with amphotericin B may be useful in determining the sensitivity of *Candida albicans* to this new antibiotic. Our investigation was directed at the study of these latter problems.

### METHODS

Ninety-three strains of *Candida albicans* organisms, either isolated from clinical specimens or obtained from the stock culture collection of various laboratories, were studied for sensitivity to amphotericin B by standard (for other antibiotics) disc sensitivity procedures. The stock cultures of *Candida albicans* strains studied were obtained from the following sources: five strains from the American Type Culture Collection; sixteen strains from the stock culture collection of the Mycology Department of the College of Physicians and Surgeons, Columbia University (originally obtained from the American Type Culture Collection); thirty-two organisms from the stock culture collection of

From the Departments of Bacteriology and Dentistry, Francis Delafield Hospital, College of Physicians and Surgeons, Columbia University.

Amphotericin B discs for this study were provided by The Squibb Institute for Medical Research, New Brunswick, New Jersey.

The Squibb Institute for Medical Research, New Brunswick, New Jersey; and five stock cultures from St. Luke's Hospital, New York City. The remaining thirty-five clinical isolates were obtained (1) from patients with suspected oral monilial lesions; (2) from essentially normal mouths of patients presenting for treatment at the School of Dental and Oral Surgery of Columbia University; or (3) from specimens submitted for culture to the Bacteriology Laboratory of the Francis Delafield Hospital, New York City. The presence of *Candida albicans* in the clinical isolates was confirmed in all cases by study for chlamydospores on suitable agar.

Disc sensitivity testing procedures were undertaken according to the following procedures: The cultures of *Candida albicans* studied were grown on Sabouraud maltose agar slants for forty-eight hours. Each culture was then transferred with a sterile swab to a Sabouraud maltose agar plate and one 6 mm. amphotericin B disc (prepared by the Baltimore Biological Laboratories and containing 30 mcg. of amphotericin B) was placed on each inoculated plate. Readings of the zone of inhibition about each disc were made after incubation for twenty-four hours at room temperature. These were checked again after forty-eight hours. Control studies with "blank" unmedicated discs were also made on eighty of the ninety-three organisms.

## RESULTS

In these studies to determine the sensitivity of the ninety-three strains of *Candida albicans* to amphotericin B, the width of the zone of inhibition about the disc of amphotericin B was approximately 3 mm. or more from the disc border in six instances, approximately 2 to 3 mm. in sixty-two instances, approximately 1 to 2 mm. in twenty-five instances, and in no instance was a zone of inhibition of less than 1 mm. noted. No zone of inhibition was discernible surrounding any of the unmedicated control discs.

From these studies, it can be concluded that amphotericin B was active in some measure against all ninety-three strains of *Candida albicans* tested under the conditions of this experiment in which discs containing 30 mcg. of amphotericin B were used.

## DISCUSSION

At the present time any consideration of amphotericin B must inevitably involve a comparison with Mycostatin. The particular importance of amphotericin B as an antifungal antibiotic in terms of oral therapy concerns the essential absence of taste associated with its topical application in comparison with the offensive taste of Mycostatin.

At present there is still a need for basic comparative studies of amphotericin B and Mycostatin under controlled conditions, since it is not implausible that amphotericin B may be more effective against some organisms against which Mycostatin is relatively less active, albeit still active, and vice versa.

SUMMARY

Disc sensitivity studies concerned with the activity of a new antifungal antibiotic, amphotericin B, against ninety-three strains of *Candida albicans* organisms, including both stock culture specimens and recent clinical isolates, are described. Amphotericin B was found to be active in some measure against all ninety-three strains studied, as evidenced by the presence of a zone of inhibition of *Candida albicans* organisms about antibiotic discs containing 30 mcg. of amphotericin B.

The authors express their gratitude for the assistance of Mrs. Doris Tormez and Mrs. Barbara Slaughter.

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630 WEST 168TH ST.

# ANNOUNCEMENTS

## First District Dental Society

The Section on Oral Surgery will meet at 8 P.M. on Wednesday, Nov. 23, 1960, at the Society's headquarters on the eighteenth floor of Hotel Statler in New York City. Captain Roger Gerry of the Navy Dental Corps will read a paper on "Complete Mouth Extraction With Immediate Denture Replacement."

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## Greater Miami Chapter of Alpha Omega

The third annual "Sunshine Seminar" will take place at the Deauville Hotel in Miami Beach, Florida, Jan. 20 to 23, 1961. The theme of this year's seminar is "Occlusion," and the clinicians are Morton Amsterdam and Walter Cohen of the University of Pennsylvania, Harry Sicher of Loyola University School of Dentistry, Chicago College of Dental Surgery, and Vincent Trapozzano of St. Petersburg, Florida. Tuition is $150.00.

All inquiries and requests for reservations should be sent to Dr. Irving Gordon, 420 Lincoln Rd., Miami Beach, Florida.

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## University of Alabama

The School of Dentistry announces that the following refresher courses will be offered during the month of December, 1960:

Oral Cancer. Leonard Robinson. December 3 and 4.

Preventive Orthodontics. Sidney B. Finn and H. Perry Hitchcock. December 10 to 12.

Further information may be obtained from The Director, Refresher Course Program, University of Alabama School of Dentistry, 1919 7th Ave. South, Birmingham 3, Alabama.

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## Boston University and Massachusetts Memorial Hospitals

The Department of Stomatology, Division of Graduate Studies, School of Medicine, Boston University and the Massachusetts Memorial Hospitals, announces the following postgraduate courses:

Periodontal Therapy. Henry M. Goldman, Bernard S. Chaikin, Gerald M. Kramer, William Pendergast, Jack Bloom, and associates. Nov. 7 to 11, 1960. $175.00.

Fixed Bridge Prosthesis. Leo Talkov, David J. Baraban, and Lloyd Warshauer. Nov. 14 to 18, 1960. $175.00.

Full Denture Prosthesis. Chester Landy. Dec. 12 to 16, 1960. $150.00.

In addition, the following special week-end refresher courses will be given:

Pulp and Periapical Pathology. Samuel Seltzer and Israel B. Bender. Oct. 28 and 29, 1960.

Esthetics in Restorative Dentistry. Charles L. Pincus. Nov. 4 and 5, 1960.

Removable Partial Dentures. Louis Blatterfien. Nov. 11 and 12, 1960.

Comprehensive Review of Periodontal Surgical Procedures. Jack Alloy, Jack Bloom, D. Walter Cohen, Robert Gottsegen, and Gerald M. Kramer. Nov. 18 and 19, 1960.

For further information about specific postgraduate courses and for application blank, write to Director, Post-Graduate Studies, Department of Stomatology, Massachusetts Memorial Hospitals, 750 Harrison Ave., Boston 18, Massachusetts.

## Ohio Dental Society of Anesthesiology

The Society will hold its annual meeting Saturday night and Sunday morning, Nov. 12 and 13, 1960, at the Neil House Hotel in Columbus, Ohio. The following papers will be presented:

Fluothane as an Agent for Outpatient General Anesthesia. Walter Maslowski and John Zink, Lima, Ohio.

History of Nitrous Oxide Anesthesia. Fred W. Clement, Toledo, Ohio.

The Present Scope and Status of Hypnosis for Dentistry. Glenn Oliver, Columbus, Ohio.

Premedicating Techniques and Agents Which Will Improve Local Anesthesia. (Essayist to be announced.)

The Present Status of the A.D.S.A. and Its Influence Concerning Practicing Dentists. Morgan L. Allison, President of the American Dental Society of Anesthesiology.

In addition to the above-mentioned papers, there will be a panel discussion, with audience participation, concerning current anesthesia problems.

## University of Pennsylvania

The School of Dentistry announces the following postgraduate courses:

Lecture and Laboratory Course in Oral Pathology. Lionel Gold and D. Walter Cohen. One evening per week for twenty weeks, starting Nov. 3, 1960.

Ultrasonics for the General Practitioner. John H. Stine and associates. Saturday, Nov. 19, 1960.

Dentistry for Handicapped Children. Manuel M. Album and associates. Dec. 12 to 14, 1960.

Seminar on Handicapped Problems. Manuel M. Album and associates. Thursday, Dec. 15, 1960. (For persons who have attended a postgraduate course in dentistry for handicapped children.)

The Use of Ultrasonics in Periodontia. Henry M. Goldman and D. Walter Cohen. Saturday, Dec. 17, 1960.

Hypnosis Applied to Dentistry. William T. Heron. Jan. 16 to 18, 1961.

Impacted Teeth. Victor H. Frank and associates. Jan. 25 to 27, 1961.

For further information, please write to Postgraduate Courses, School of Dentistry, University of Pennsylvania, 4001 Spruce St., Philadelphia 4, Pennsylvania.

## Michael Reese Hospital and Medical Center

A completely new and unique format in a postgraduate course for dentists will be introduced by the Dental Department of Michael Reese Hospital and Medical Center on Oct. 24, 25, and 26, 1960.

The course, entitled "The Management of Surgical Complications in Dental Practice," will be under the direction of the Oral Surgery Section and will include on its faculty outstanding dentists and physicians. This course will be especially valuable to the practicing dentist since, in addition to advancing and supplementing his knowledge in the prevention

and treatment of everyday complications, the course will be correlated and integrated with those areas of medicine which play an important role in complications influenced by diseases of systemic origin. This will include allergy, diabetes, cardiac, hormonal, and hematologic disturbances, and ear, nose, and throat complications.

An innovation will be the demonstrations and class participation in the particular steps necessitated by the involved systemic disorder, such as giving various types of injections, resuscitation, laboratory tests which can be performed in the dental office, suturing, and packaging for sterilization.

The fee for the three-day course is $150.00. Enrollment will be limited. For further information and the complete program, write to Dental Department, Michael Reese Hospital and Medical Center, 29th St. and Ellis Ave., Chicago 16, Illinois.

## Temple University

The School of Dentistry announces the following graduate and postgraduate courses for 1960-61:

Clinical Endodontics. Leonard Parris and associates. Oct. 31 to Nov. 5, 1960. Tuition, $175.00. Enrollment limited to ten.

High Speed in Operative Dentistry. Carlos Weil and Charles A. Nagle, Jr. Dec. 7, 1960, and March 1, 1961. Tuition, $35.00. Enrollment limited to ten.

Implant Dentures. Aaron Gershkoff and Norman I. Goldberg. Jan. 9 to 13, 1961. Tuition, $200.00.

Anatomy—Head and Neck Dissection. Richard M. Snodgrasse. Feb. 1 to May 17, 1961 (fifteen Wednesdays, from 1 to 5 P.M.). Tuition, $300.00. Enrollment limited to six.

Advanced Fixed Prosthesis. George Straussberg. Feb. 6 to 11, 1961. Tuition, $200.00. Enrollment limited.

Present-Day Periodontal Practice. Jacoby T. Rothner, Irving Glickman, Bernard Saturen, and Neal W. Chilton. Feb. 14 to April 18, 1961 (each Tuesday for ten weeks). Tuition, $250.00. Enrollment limited to ten.

Practice Administration. Jay H. Eshleman. Feb. 18, 1961. Tuition, $25.00. Enrollment limited to twenty.

Periodontal Prosthesis. Morton Amsterdam, D. Walter Cohen, and associates. Feb. 20 to 24, 1961. Tuition, $275.00. Enrollment limited.

Electronic Electrosurgery. Maurice J. Oringer. March 3 and 4, 1961. Tuition, $60.00. Enrollment limited.

Immediate Surgical Endodontics. Leonard Parris, Harold Rappaport, and Robert Uchin. March 6 to 11, 1961. Tuition, $175.00. Enrollment limited to eight.

Advanced Surgical Techniques in Periodontal Therapy. Saul Schluger and Jack Alloy. March 25 to 29, 1961. Tuition, $300.00. Enrollment limited to ten.

Full Denture Prosthesis. Bernard Jankelson and associates. May 8 to 12, 1961. Tuition, $200.00. Enrollment limited.

Graduate Orthodontics. Robert B. Hedges and associates. Sept. 7, 1961 (a two-year course). Tuition $450.00 per semester.

For application and additional information, write to Dr. Louis Herman, Director of Postgraduate Studies, Temple University School of Dentistry, 3223 North Broad St., Philadelphia 40, Pennsylvania.

## Mount Sinai Hospital Oral Pathology Conference

The first clinical oral pathology conference of the season will be held at 4:30 P.M. on Friday, Nov. 18, 1960, in Lecture Room 3-B on the third floor of the Administration Building, Mount Sinai Hospital, New York, New York. The topic will be "Pathology of the Periapical Tissues," and the speaker will be Dr. Lester R. Cahn.

## Internships Available at VA Hospital in Philadelphia

The Veterans Administration Hospital in Philadelphia, Pennsylvania, is now accepting applications for one-year rotating internships available July 1, 1961. The program is given in cooperation with the affiliated dental and medical schools, and a certificate of internship is awarded by the Hospital.

For further information, write to Dr. S. L. Orlean, Chief, Dental Service, Veterans Administration Hospital, Philadelphia 4, Pennsylvania.

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## Medical College of Virginia

The School of Dentistry announces the following postgraduate courses:

Pedodontic Workshop. William S. Kramer (University of Nebraska), Robert A. Senescu (Department of Psychiatry, Medical College of Virginia), and Henry M. Wilbur (University of Louisville). Nov. 3 to 5, 1960. Tuition, $52.00 (includes hotel and meals at Natural Bridge, Virginia).

Clinical Occlusion. Arne G. Lauritzen (Seattle, Washington). Feb. 11 to 15, 1961. Tuition, $150.00.

Oral Surgery. Elmer Bear and W. J. Longan (Medical College of Virginia). March 6 to 8, 1961. Tuition, $75.00.

Anatomy of the Head and Neck. Alton D. Brashear (Medical College of Virginia). March 13 to 17, 1961. Tuition, $75.00.

Complete Denture Prosthesis. M. M. DeVan (University of Pennsylvania). March 20 to 24, 1961. Tuition, $150.00.

Clinical Photography. Melvin C. Shaffer and P. J. Modjeski (Medical College of Virginia). April 10, 1961. Tuition, $25.00.

For further information, write to Dr. H. T. Knighton, Director of Postgraduate Instruction, School of Dentistry, Medical College of Virginia, Richmond, Virginia.

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## Albert Einstein College of Medicine, Yeshiva University

The Department of Dentistry will sponsor postgraduate courses in anesthesiology, endodontia, oral surgery, periodontia and prosthetics during the spring of 1961. These courses are designed to be integrated into the general dental practice. Lecture sessions will be held at the Albert Einstein College of Medicine, and the clinical demonstrations will be given at the Dental Clinic of Jacobi Hospital.

For further information and application, please write to Director, Postgraduate Dental Division, Albert Einstein College of Medicine, Eastchester Rd. and Morris Park Ave., Bronx 61, New York.

# REVIEWS OF THE LITERATURE

## BOOK REVIEWS

**Periodontal Therapy.** Henry M. Goldman, D.M.D., F.A.C.D., Professor of Stomatology and Chairman of the Department of Stomatology, Boston University School of Medicine, Chief of the Department of Stomatology, A. S. Burg Clinic, Massachusetts Memorial Hospitals, Boston, Mass., Director of the Riesman Dental Clinic, Beth Israel Hospital, Boston, Mass., Professor of Periodontology, University of Pennsylvania Graduate School of Medicine, Philadelphia, Pa.; Saul Schluger, D.D.S., Director of Graduate Dental Education and Professor of Periodontics, University of Washington School of Dentistry, Seattle, Wash., Lecturer in Periodontology, University of Pennsylvania Graduate School of Medicine, Philadelphia, Pa., Postgraduate Faculty, University of Southern California, Los Angeles, Calif.; Lewis Fox, D.D.S., F.A.C.D., Associate Professor of Periodontology, University of Pennsylvania Graduate School of Medicine, Philadelphia, Pa., Associate Clinical Professor of Dentistry, Columbia University School of Dental and Oral Surgery of the Faculty of Medicine, New York, N. Y.; and D. Walter Cohen, D.D.S., Associate Professor of Oral Medicine, University of Pennsylvania School of Dentistry, Philadelphia, Pa., Associate Professor of Periodontology and Co-Chairman of the Department, University of Pennsylvania Graduate School of Medicine, Special Guest Lecturer in Stomatognathology, Temple University School of Dentistry, Philadelphia, Pa., Consultant in Periodontology, Veterans Administration Hospital of Philadelphia and Valley Forge Army Hospital, Philadelphia, Pa., Member of Dental Staffs of Albert Einstein Medical Center, Philadelphia General Hospital, and Children's Hospital of Philadelphia. Second edition. St. Louis, 1960, The C. V. Mosby Company. Price, $18.75.

This edition has been thoroughly revised and rewritten for the purpose of including information on rapidly expanding variations in technique which are becoming available today. The general practitioner will be interested in a step-by-step plan of procedures in the sections on treatment planning and on prognosis.

There are 656 pages, which include 100 pages of photographs and explanatory legends.

*Thomas J. Cook.*